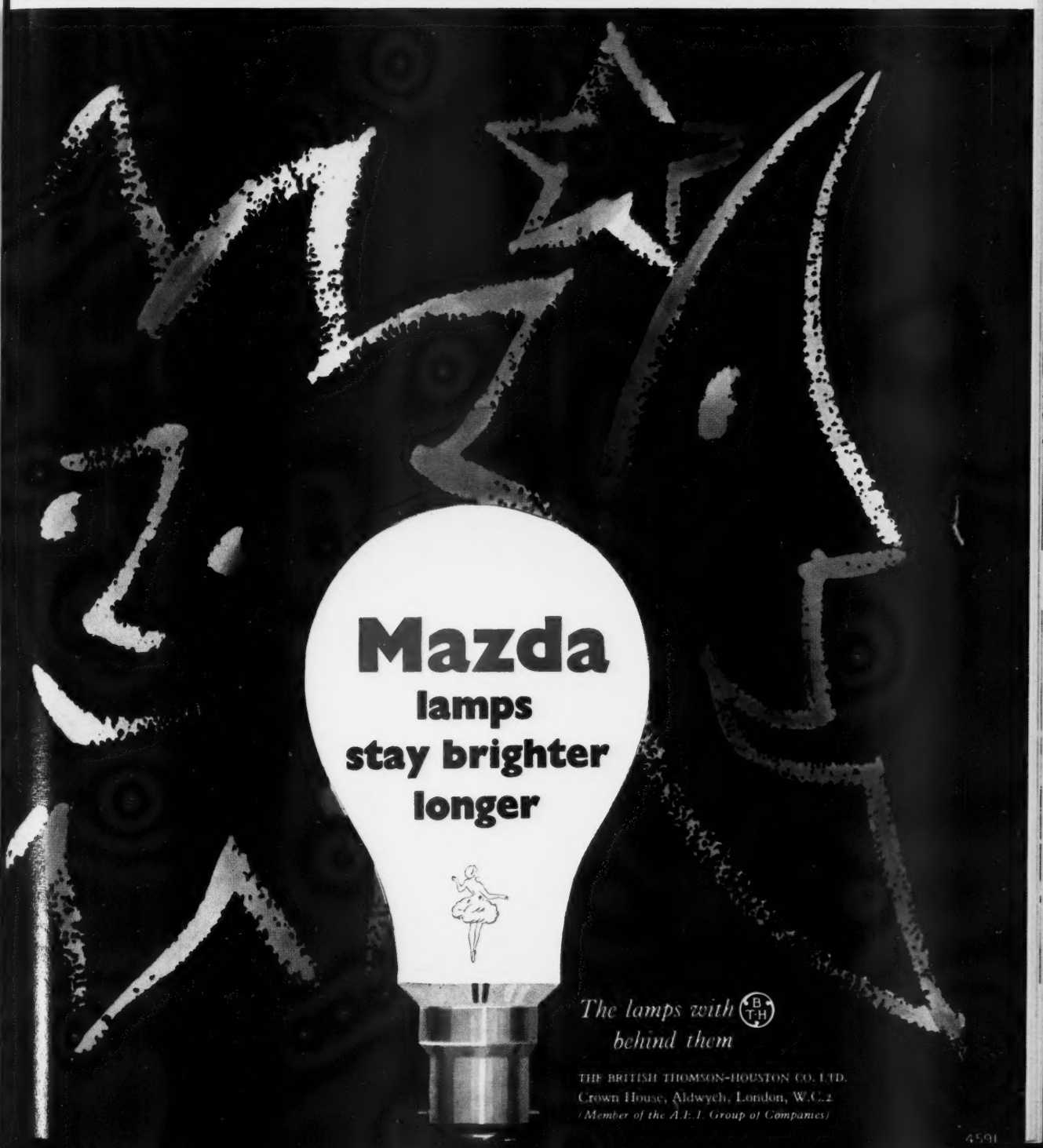
ELECTRICAL REVIEW



STANTON

The Stanton No. 8D Prestressed Spun Concrete Lighting Columns shown in our picture are part of the Company's No. 8 series; as with all Stanton Group "A" Columns, they are acceptable to the Ministry of Transport for use on Trunk Roads.

THE STANTON IRONWORKS COMPANY LIMITED—NEAR NOTTINGHAM

ELECTRICAL REVIEW

Managing Editor: HUGH S. POCOCK, M.I.E.E.
General Editor: J. H. COSENS
Technical Editor: P. W. TUCKER, M.I.E.E.

18 NOVEMBER 1955

In This Issue

965 ALTERNATIVE ENERGY SOURCE
967 UNDERGROUND GASIFICATION
972 FLUE GAS EMISSIONS
973 MEASUREMENT OF NOISE AND VIBRATION
975 FUEL RESEARCH IN HOLLAND
977 PERSONAL AND SOCIAL
978 E.I.B.A. BALL
981 VIEWS ON THE NEWS
982 INDUSTRIAL NEWS
985 CATHODE-RAY TUBE MANUFACTURE
987 PARLIAMENTARY REPORT
989 SCIENCE IN WESTERN GERMANY
991 LETTERS TO THE EDITOR
993 SEMI-CONDUCTOR RECTIFIERS
996 AHMEDABAD "C" POWER STATION
999 NEW ELECTRICAL EQUIPMENT
1001 GENERATION AND DEVELOPMENT
1003 NEXT WEEK'S EVENTS
1004 FINANCIAL SECTION
1008 NEW PATENTS
1009 CONTRACT INFORMATION

VOLUME 157 ✧ NUMBER 21

Eighty-Fourth Year of Publication

FRIDAY ✧ PRICE 1s 6d

137 CLASSIFIED ADVERTISEMENTS
150 INDEX TO ADVERTISERS

Editorial, Advertising and Publishing Offices: Dorset House, Stamford Street, London, S.E.1. Telegraphic Address: "Elecrev, Sedist, London." Code: ABC. Telephone No. Waterloo 3333 (60 lines). Registered at the General Post Office as a Newspaper. Entered as Second Class Matter at the New York, U.S.A., Post Office. Annual Subscription: Home and Overseas £4 10s 0d: U.S.A. and Canada $14.00. Cheques and Postal Orders (on Chief Office, London) payable to ELECTRICAL REVIEW PUBLICATIONS LTD., and crossed "Lloyds Bank."

"Inkwell"

GRAPHIC INSTRUMENTS

Unique Visibility and Chart Width

PANEL SPACE:

PROJECTING $8\frac{3}{8}$" x $11\frac{7}{8}$"

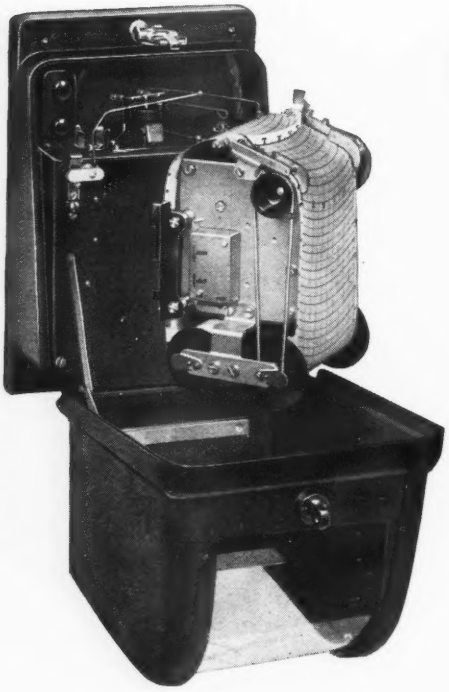
FLUSH $10\frac{3}{4}$" x $14\frac{3}{8}$"

VISIBLE CHART $4\frac{1}{2}$" wide, 8" long

No recorder of comparable size gives such unique visibility and chart width.

Send for

CATALOGUE SHEET No 300A



Movements: High Torque, High efficiency type, screened and magnetically damped.

Pen: Syphon type, minimum friction, unaffected by level of ink.

Ink: Central inkwell, large capacity, easily accessible.

Chart: Roll type, speeds up to 12" per minute.

Chart Drives: Swing pattern for easy access, electrical or spring drive.

Flush Pattern: All working parts move forward automatically when case is opened.

Indicating Scale: Always visible, with 8" of completed record.

For best results always use "Inkwell" Charts.

EVERETT EDGCUMBE

Designers and manufacturers of almost every type of electrical indicating and recording instrument. Specialists in: Speed Recording, Photometry, Process Time Control, Telemetering.

COLINDALE WORKS, LONDON N.W.9. TELEPHONE: COLINDALE 6045

DHB/2043

ELECTRICAL REVIEW

18 November 1955 Vol. 157 No. 21 Established 1872

Alternative Energy Source

FOR many years now the demand for electrical power has been increasing rapidly with the development of industry and the increase is bound to continue. This has led engineers and scientists all over the world to examine carefully every possible source of electrical power because coal, the basic raw material, is becoming increasingly more expensive and difficult to come by. There have been investigations into wind power, solar energy and the fuel cell, but none of these seems likely to provide an early solution to the fuel shortage problem. Even nuclear power is unlikely to make an appreciable difference to coal consumption for a decade or so.

Although there is a chronic shortage of coal it is a surprising fact that, in this country, according to the National Coal Board, there is over 300 million tons of coal which is economically unmineable by conventional means. This coal has an impermeable overburden such as clay or shale and lies between 100 and 600 ft deep in seams not less than 2ft 6in thick which are level or do not slope more than 1 in 5. This coal, as is explained elsewhere in this issue, is suitable for gasification, and it is in lots of not less than $2\frac{1}{4}$ million tons sufficiently clear of surface buildings, etc., which makes exploitation practicable. If sloping or thinner seams are also considered the total rises to over 500 million tons of coal suitable for gasification, which is sufficient to generate about 1,000 MW continuously for fifty years.

As indicated in our article, the results of five years' field work on underground gasification are encouraging as it has been proved that usable gas can be produced, often for long periods, by each of three methods: high-pressure linkage, electro-linkage and directed drilling. It would be unrealistic as yet to estimate the cost of gas production in terms of millions of tons of coal annually since the trials have been on a relatively small scale and have been directed primarily towards technical objectives. Estimates based on such factors as can be costed are not discouraging, however, if it may be assumed that gas at 2d–3d per therm (compared with power station coal at 3·3d per therm) is of interest for electricity generation. The next step in the investigations might be to install a pilot scale system (say 2,000 kW) based on the simplest technique, on which experience could be gained and costs taken out over a period of two or three years.

Underground gasification does not necessarily mean using up coal which could economically be mined sooner or later, nor does it require the large scale employment of skilled miners whose limited numbers are one explanation of the lag in our deep-mine coal production. The successful exploitation of indigenous supplies of coal by underground gasification, if it can be brought about, could not only constitute a new fuel and power industry with an annual turnover rising to over £50 million but also with further profitable overseas implications.

INTERNATIONAL RESEARCH

In this issue we have described the International Flame Research Committee's facilities at Ijmuiden, in Holland, and the inauguration of their new furnace for pulverized fuel research. It was evident from those present that great faith was being placed in this experimental station, individual programmes of research having been curtailed because of the much better facilities available. To this country in particular the benefits of any increase in fuel utilization efficiency are considerable and the Central Electricity Authority is keenly interested in the trials being carried out. Also evident was the enthusiasm with which engineers from several countries, including our own, were working at Ijmuiden in close collaboration on their common problems. Stressed time after time was the value of this international co-operation to the countries concerned, to the engineers themselves, and to their work. This has the benefit of different trainings, attitudes of mind and approaches to the solution of problems. The ability to see the same problem in a different way is a valuable one, particularly so in deciding on a line of research or evaluating its consequences. There are many international organizations in existence in the engineering world, but not many maintain working establishments of this nature: benefits in many fields might well accrue from a more extensive adoption of the policy.

DRAUGHT AND CHIMNEYS

We wonder how many engineers will be "caught out" by the declaration by Messrs. J. E. Hawkins and G. Nonhebel in their paper dealing with flue gas emissions, reported elsewhere in this issue, that tall chimneys of modern power stations are not required to create draught but to improve dissipation of the leaving gas by discharging it at a great height. Correctly designed chimneys do, of course, contribute considerably to the draught system and there are probably still many small (works) power stations in existence where the draught inducing characteristics of the chimney are relied on entirely for the necessary combustion air flow through the boiler furnaces. The fact remains, however, that in large power stations at any rate the creation of the necessary air flow is the function of the forced draught and induced draught fans which are a much more economical proposition than extremely expensive chimneys which would be required to create the entire air flow required. We think that in many text books the real function of the tall chimney has not been fully explained, undue emphasis having been given to the draught creating contribution.

AUTOMATION

In many ways it seems a pity that the word automation was coined for it is giving many people an entirely false impression of the technique of automatic control. As the word is a comparatively new one, rolls off the tongue easily, and has a highly "scientific" sound about it, some people are being led into the belief that an entirely new branch of science has suddenly been developed overnight which will have a far-reaching effect upon all our lives. Although there may be a grain of truth in this, the techniques of automatic control are not by any means new, but continuous and vigorous development work on automatic control systems, aimed primarily at increasing industrial productivity, is resulting in equipments which can make a vast difference to the economics of a factory. Those vizualizing robot "men" replacing factory hands are a bit off course because, generally speaking, automation means the installation of measuring and controlling apparatus designed to improve the efficiency of an industrial process and not necessarily to reduce manpower.

NUCLEAR ENGINEERING TRAINING

During the earlier stages of the development of nuclear energy it was often said that nuclear engineering was essentially a subject that must be treated quite independently of the other main engineering subjects—mechanical, electrical, chemical, etc.—and this view was held persistently when it became at first likely and then obvious that nuclear energy would be used for the generation of electricity. Even after the formation of the British Nuclear Energy Conference the same view persisted in somewhat modified terms. Now we are hearing more and more of the mingling of the subjects on the academic side and of nuclear engineering being included as just one of the subjects of a course of study in a wider engineering curriculum. For example, a new study of nuclear engineering is to be introduced this year at the Glasgow University. This will form part of the B.Sc. course, as one of the additional subjects, and it will be offered in the first instance to final year students of mechanical and electrical engineering.

KETTLE QUESTIONS

A letter in this issue from a New Zealand reader indicates a sad lack of information about British-made electric kettles which may possibly extend to other appliances and to other people. It is not true of course that the majority of these kettles are under-loaded or that they have clamped-on elements. To prove this we have sent Mr. Ruff a copy of the schedules of electric kettles published in our issue of 4th February last. In these it was clearly shown that most kettles now have immersed elements and that a common loading is 1,500 W, with several examples of 2,000 W. According to our correspondent New Zealanders prefer jugs to kettles for boiling water. Apart from the shape there seems little to choose between them but it is true that with the smaller diameter of the jug it is possible to boil smaller quantities of water. It is possibly the only drawback of the immersion-heater kettle that the element has to be covered which may sometimes mean the use of more water than is actually needed.

The survey of domestic appliances to be published in next week's issue will deal with immersion heaters and will give in tabular form details of type, length, loading, size of head, price and purchase tax. The following survey (16th December) will cover washing machines

Gasification site at Bayton based on directed drilling, showing compressor house and generating plant in right background. The dotted lines indicate the position of the horizontal boreholes through the coal seam

Underground Gasification

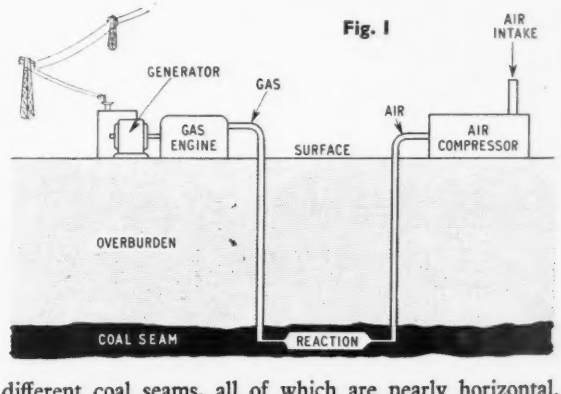
Investigations by the Ministry of Fuel and Power and National Coal Board

SINCE 1949 a series of investigations into the various methods of underground gasification of coal have been conducted in this country in an endeavour to devise means of making use of unmineable seams (i.e. impossible to mine economically by conventional methods) to produce electricity for general distribution. This work has resulted in the development of what appears to be a successful and economic solution to the problem and it now remains only for the political decisions to be made before much larger scale experiments are initiated in which more substantial quantities of electrical power can be generated and fed into the national grid system.

Essentially, underground gasification consists of passing air through a burning coal seam and bringing the resultant gas to the surface for use (see Fig. 1). Following trials in other countries useful gas was first produced here by this means in 1950. Since then over three dozen trials, with an average gasification of nearly 100 tons of coal apiece, have been carried out on two sites under the joint sponsorship of the Ministry of Fuel and Power and the National Coal Board. The importance of the project becomes obvious when it is realized that there are more than 500 million tons of unmineable coal in this country which is suitable for gasification. This is sufficient to generate at the rate of 1,000 MW continuously for 50 years.

There is no new problem in gaining access from the surface to the coal seam by means of boreholes or shafts whereby air can be supplied and the gas brought to the surface. The creation of a channel through the coal in which the reaction can be maintained is new, however, and it is largely the cost of this channel and the amount of usable gas which can be produced from it which determines whether or not the gas can be made available sufficiently cheaply for the generation of electricity. So far, three methods of making these channels have been tried in six different coal seams, all of which are nearly horizontal. These methods are known as high-pressure linkage, electrolinkage and directed drilling, respectively. In each case combustible gas capable of use in prime movers for electricity generation has been produced.

Fig. 1



The Gas Reaction

When coal burns in free air it produces heat and incombustible flue gases. If it burns in an insufficiency of air the reaction is incomplete and the gas formed may be combustible. This is the basis of the "producer gas" reaction. If water or steam are present a better quality gas, "water gas" is made. If coal is heated in the absence of air the volatiles (representing 15-40 per cent of the weight of bituminous coals) are driven off as "coal gas."

The result of the reaction in underground gasification is a mixture of two or more of the following: coal gas, water gas, producer gas, flue gas and sometimes some free air. The coal and the resulting coke are gasified and the potential heat in the original coal comes to the surface as potential heat (combustible gas), sensible heat (hot gas), and steam, while some of the heat is lost by conduction underground into the surrounding strata. Typical analyses and calorific values of the constituent gases from under-

	CO_2%	O_2%	CO%	CH_4%	C_nH_m%	H_2%	N_2%	C.V. (B.Th.U/cu ft)
Coal gas	2	½	8	30	3½	52	4	560
Water gas (coke)	4½	—	41	1	—	49	4½	295
Producer gas (coke) ...	7	—	26	½	—	12	54½	126
Flue gas (undiluted) ...	18	—	—	—	—	—	82	—
Air	—	21	—	—	—	—	79	—

ground gasification are indicated in the table on page 967.

In addition to or instead of potential heat expressed as c.v. the mixed gases may contain sensible heat, a temperature of 500 deg C, for instance, representing about 15 B.Th.U./cu ft. In theory, the life history of the gasification process in a passage through the coal would be in four successive stages as the channel became wider with the disappearance as gas of the coal and coke:—

(*a*) Enrichment of the producer gas by coal gas from the distillation of the volatiles in the coal, and from water gas if and while the seam is wet.

(*b*) Producer gas by successive oxidation of the coke and reduction of the CO_2 to CO.

(*c*) As the channel widens a reduction in c.v. but increase in exit temperature when some of the air fails to make contact with the coke but mixes with and burns gas which has been formed.

(*d*) Some of the air passes unchanged through the channel, dilutes the exit gas, and reduces its temperature.

These stages are often recognizable in underground gasification but generally at a lower level of c.v. than might be inferred from the values quoted for the constituent gases. Values above 150 even in the initial stages are unusual and the gas in the second stage is generally below 100. Below about 75 the gas is increasingly difficult to burn and yields a decreasing temperature on combustion. By alternating steam and blow in a dry seam a controlled water gas reaction can be encouraged and a higher c.v. is then obtained during the steaming period. By using oxygen or oxygen enriched air, the nitrogen content is reduced which raises the c.v. both because of the higher reaction temperature and the diminished dilution (with nitrogen) of the end product. Other variants of possible benefit in the gasification process are the preheating of the air supply, or the recirculation of some of the products of combustion.

Methods of Linkage

To pass air through a coal seam and recover the gas formed, there must be a passage down to the coal, through the coal and up to the surface. Conventional means (e.g. drilling of boreholes) are available to make access from the surface to the coal. The forming of a channel for air and gas through the coal seam is an unusual problem and a variety of possible techniques present themselves. In the high-pressure linkage method high-pressure air, with or without oxygen enrichment, is forced from the bottom of one vertical borehole into the coal through the seam, and up another borehole to the surface some distance away. This enables a passage to be burnt through the coal seam which can then be gasified. Although this method has yielded its successes, it proved to be insufficiently reliable without further prolonged work and its development has been suspended.

The electro-linkage method shows more promise and in the United States spans of about 155ft have been linked and subsequently gasified with low-pressure air. In principle, " electro-linking " consists of two stages. Electrodes are inserted down boreholes to make contact with the coal, and electric power is passed between them. The first effect is a release of heat sufficient to dry out the water near the electrodes and this causes a substantial increase in electrical resistance. By adjusting the voltage to maintain the power input a large heat release near the electrodes begins to carbonize the coal and the resistance falls, since coke is of low electrical resistance in contrast to the coal which is of high resistance. Thereafter the carbonization process is progressive and extends outwards from each electrode with a growing bias towards the opposite electrode.

This directional bias renders the process attractive as compared with the high-pressure linkage, where no such bias was found. The coking proceeds until the two coke boundaries meet when the electrical resistance falls suddenly to a low value and there is a concentration of power release in the coke path. This completes the " electro-linking " phase proper. Thereafter a heavy current can be caused to flow between the electrodes to form more coke, this coke developing the usual fissures. Throughout both phases good quality distillation gas is evolved.

If, at the appropriate stage, air at high pressure is passed down one of the boreholes, it soon establishes a low-pressure path through the coke joining the boreholes, and the electrodes, etc., can then be withdrawn. It has been claimed in the United States that this fissured fuel bed behaves quite differently from an open hole or other main passage through the coal and is more nearly similar to a fragmented producer gas fuel bed in the sense that the reaction moves only slowly and on a wide front from the one borehole to the other, meanwhile gasifying a substantial amount of the coke resulting from the electro-carbonizing. This might have advantages in terms of higher gas quality and the absence of the need for reversals but on the other hand there is probably a higher pressure loss. The formation of this fuel bed has not yet been confirmed in this country and trials based on electro-linkage were started first at Bayton in Worcestershire as only on that site was mains electricity then available. Arrangements were made with the Midlands Electricity Board for the provision of a 1,500 kVA single-phase supply, which was fed through a bank of nine transformers, lent by the National Coal Board, and so arranged as to allow a variety of interconnections by which the voltage could be dropped in stages to match the fall in resistance between the electrodes as the linkage proceeded. After carrying out a number of trials on the non-coking coal at Bayton the equipment was transferred to Newman Spinney to carry out trials in a coking coal. The East Midlands Electricity Board made similar special arrangements for a 1,500 kVA single-phase supply to that site.

In one of the trials at Bayton a 40ft span was first linked at a starting voltage of 2,000 V and some 4,000 kWh was used during the electro-linkage phase followed by a further 12,000 kWh during the electro-carbonizing phase, when the resistance was down to 0·25Ω (300 V). These two

Directed drilling in progress at Bayton

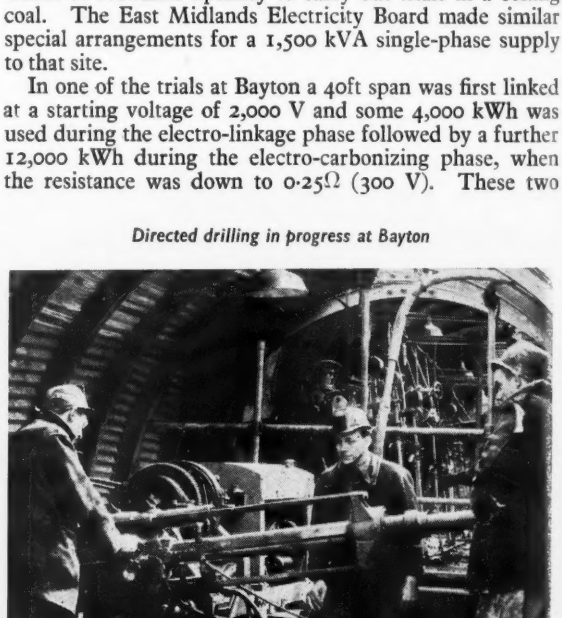


Fig. 2

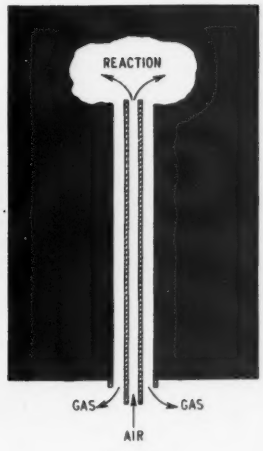


Fig. 3

electrodes were then withdrawn. The starting voltage was then applied to two other electrodes 100ft apart on the line of the original span to give a 30ft extension at each end. This second double linkage was also successfully accomplished.

During the electrification period the c.v. of the gas evolved was 260-340 B.Th.U./cu ft. The total electricity used for the 100ft span was about 26,000 kWh or 260 kWh per ft. The subsequent low-pressure gasification phase lasted about 2½ months during which about 200 tons of coal were gasified at an average c.v. of 50 B.Th.U./cu ft. The pressure mostly remained high at about 20 lb/sq in owing to a local restriction (70ft of the total 100ft could be operated at less than 5 lb/sq in). Air rates of up to 70,000 cu ft/hr were used (average about 20,000 cu ft/hr) and tests on the effect of preheating were carried out. Owing to the relatively high pressures used for much of the time in this faulted area there was considerable leakage of gas to the surface other than through the upcast. Although a good measure of success has been achieved with this method much more work must be done before a completely satisfactory technique is developed and the investigations are continuing.

Improved Drilling Technique

While the experiments on electro-linkage were being conducted it was learnt that Boyles Bros. Drilling Co. had developed an improved drilling technique in connection with long wall blasting whereby it was possible to drill accurately and for long distances into the coal seam at low cost. Earlier work had shown in 1950 that over 150 tons of coal could be usefully gasified using a borehole in the coal only 50ft long. With longer boreholes and a correspondingly greater gas yield the cost of gas production at the coal face should be very low.

Although techniques have been used to bend the direction of a borehole from the vertical to the horizontal they are expensive and it seemed preferable to plan the technique on the basis of taking the drill rig underground by means of a small shaft which might subsequently be used as access for the air and gas supply lines. The construction of shafts and galleries raises no novel problems and each skilled underground worker so employed should lead to the exploitation of fifty times as much coal as he could extract by conventional mining. The cost of this preparatory work could be spread over many boreholes so as not to inflate unduly the cost of the gas produced.

Drilling operations were started at Newman Spinney in 1953 with almost immediate success in keeping the drill bit in the coal over long distances. The technique used involves the use of drag bits with tungsten carbide inserts forming the cutting edges, the drill head being designed to allow accurate thrust control. The weight of the bit is balanced with a stabilizer which acts as a fulcrum to raise or lower the bit according to its position and the thrust pressure. Whether change in direction is required is determined by the penetration rate, by examination of the chippings washed back in the flush water and by core samples, with further confirmation by actual survey of the hole. Success with the technique depends upon the driller's experience and upon detailed knowledge of the characteristics of the seam and of its roof and floor.

At Newman Spinney, fifteen 4in diameter boreholes (some reamered out to 8in diameter) have been drilled to a total length of over 850 yd, the last one to nearly 200 yd without passing out of the coal, and this distance could be exceeded at the cost of some slowing down in the drilling rate with increase in cost.

At Bayton directed drilling was difficult as the exposed coal was only 16in thick and the roof and floor were so nearly identical that it was difficult to recognize from the chippings when the drill passed out of the coal whether it had gone up into the roof or down into the floor. Nevertheless, after abandoning two preliminary holes four more holes were drilled which for most of their length were in coal, the longest being 290ft. The drilling rate was slower than at Newman Spinney. These successes under difficult conditions justified the construction of a miniature system of shafts and underground galleries to enable the drill rig to be used underground under conditions similar to those envisaged for a full-scale system.

The preliminary gasification trials based on directed drilling were planned to explore the possibilities of two different methods of gasifying the boreholes in the coal, one using open boreholes and the other blind boreholes. In both methods all men would be brought to the surface before ignition of the coal. In the open borehole method connection for air and gas is made to each end of the borehole in the coal (see Fig. 2). In practice this could be done by driving parallel galleries, and drilling between pairs of galleries a number of parallel boreholes at appropriate spacing. It would appear that at normal air rates the reactions will move along the boreholes in the direction of air flow thus necessitating occasional reversal. These movements may not keep in phase and individual control of each borehole might be necessary. It may, however, be possible to prevent such movement of reaction and the need for reversal if preheated air is used.

A more convenient arrangement would be to drill blind boreholes into the coal without attempting to make intersection with another gallery at the far end. In its simplest form two parallel boreholes could be drilled at no great distance apart, connection being made at the far end by burning through or by electro-linkage. Air passed up one borehole should result in gas coming out of the other. An alternative would be to use each borehole as an independent unit, the air being carried up to the far end of the hole by a pipeline which is smaller than the borehole and thus allow the gas to pass back between the pipe and the borehole wall (see Fig. 3). This will have the effect of heating the pipeline and so of preheating the air supply. As a result the reaction should not move back to the face other than very slowly as the coal is exhausted and the end of the pipeline burnt away. Reversals would then not be necessary.

A trial is now in progress at Bayton to prove the practicability of directed drilling underground and to operate a multiple borehole system to gasify some 2,000 tons of coal during an uninterrupted run of about four months.

With an air rate of 100,000 cu ft/hr about 15 tons of coal should be gasified daily yielding about 100 therms per hour (capable of generating nearly 750 kW).

The system is based on the "open borehole" method as being further advanced than the "blind borehole" method, and not necessarily as the better method in the long run. Four parallel boreholes 30ft apart are drilled in the seam from one gallery at coal level to another 200ft away. The galleries run down dip so that the boreholes are nearly horizontal (average depth 80ft). The two shafts giving access to the galleries are 6ft 6in in diameter (see Fig. 4). As it is desirable to exercise independent control over the four reactions vertical boreholes have been drilled, two for each horizontal borehole, to intersect at about 15ft in from the gallery faces. The horizontal boreholes are sealed between these intersections and the faces.

Means are provided for preheating the air supply at the surface if required. The boreholes are ignited in succession at intervals until the intended gas output is obtained. This involves two or three reactions in simultaneous operation. When the gas quality on the first reaction becomes useless another borehole is ignited and the exhausted one closed down. Most of the gas is burnt off or blown to waste but some is used in a high compression reciprocating gas engine to generate electricity.

Cost of Preparatory Work

In the preparations for this trial the total cost of the work was £9,607. If half the energy in the 2,000 tons of coal is brought to the surface in usable form the total yield is 300,000 therms, and the cost of the preparatory work would be 7·7d per therm. This would be prohibitive, but in a complete system boreholes would be drilled on both sides of each gallery so that each set of boreholes would carry the cost of only one shaft and gallery. The preparatory cost to be allocated to the four boreholes would then be £5,338 or 4·3d per therm.

The scale of the system is far below any commercial pattern. If the galleries were 200 yd apart and each 300 yd long the coal to be exploited would be increased to 60,000 tons and the yield should be about 9 million therms. The preparatory work at this shallow depth would then cost nearly £29,000 or 0·8d per therm. If for the greater depth the shaft cost say ten times as much the preparatory cost would increase to 1d per therm.

The pressure at which the air has to be pumped to supply the reaction varies according to the technique used for linkage, the length of span and the air rate. On occasions it has been below 1 lb/sq in when the cost of pumping is not of much account, but at higher pressures it may become significant depending also on the c.v. of the gas. On the basis of 0·62d per h.p.-hr (including capital charges on pumping plant) the pumping cost at 10 lb/sq in is about 0·4d per therm on 100 B.Th.U./cu ft gas but 1d per therm on 50 B.Th.U./cu ft gas, the former being significant but probably acceptable, while the latter might be prohibitive.

Only infrequently and for short periods has the c.v. much exceeded 100 B.Th.U./cu ft when using air (with oxygen enrichment higher values are to be expected). The proportion of carbon dioxide has been higher and that of the hydrocarbons lower than might be expected. In time the c.v. tends to fall and the upcast temperature to rise, followed by the appearance of oxygen in the exit gases. The gas quality then generally continues to fall and the proportion of oxygen to rise.

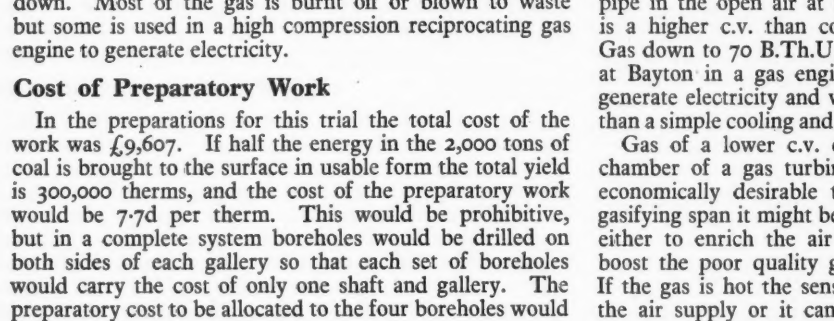
It has been found difficult to burn the gas on the stack pipe in the open air at below 80 B.Th.U./cu ft but this is a higher c.v. than could be used in a prime mover. Gas down to 70 B.Th.U./cu ft has been successfully used at Bayton in a gas engine of compression ratio 14/1 to generate electricity and with no auxiliary equipment other than a simple cooling and cleaning box for the gas.

Gas of a lower c.v. can be burnt in the combustion chamber of a gas turbine of special design. If it were economically desirable to extend the useful life of the gasifying span it might be preferable on nearing exhaustion either to enrich the air with oxygen (and steam) or to boost the poor quality gas with oil at the prime mover. If the gas is hot the sensible heat can be used to preheat the air supply or it can be used direct with the gas to raise steam or to heat the heat exchanger of an air cycle gas turbine. The economic minimum range for the blended gas is likely to be between 70 and 50 B.Th.U./cu ft.

It is not yet possible to state precisely the thermal yield from the coal gasified in terms of the proportion of useful energy brought to the surface. During the early stages over 50 per cent of the heat in the coal has been available as potential heat and a further 10 per cent as sensible heat. Averaged over the useful life of the reaction the total yield is less with a smaller proportion as potential heat and a larger proportion as sensible heat. These results have been obtained at comparatively low air rates in wet seams when the heat losses by conduction underground and as low-grade steam brought to the surface were a higher proportion of the total heat release than is the case at higher the rates since attained and which will be used.

The spread of the reaction underground is capable of close control by means of the air supply. The air can be cut off for hours or days without prejudice to restarting useful gas production at once when the air supply is re-established. This flexibility may be of economic

General view of the air blower house at Bayton



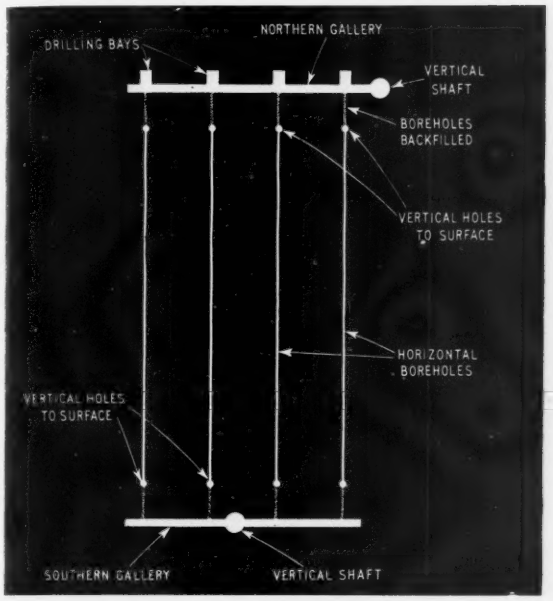


Fig. 4

significance if the process were required to meet a fluctuating demand for electricity. When the supply of air is finally cut off, the underground temperature gradually drops over a period of months without further extension of the reaction area.

At present it is too early to attempt the detailed design and costing of large-scale installations able to generate upwards of 10 MW. The trials to date have been on a small scale with limited objectives in gas production while detailed attention has not yet been given to the economic conversion of the gas into electricity. More experimental information is required and one or more pilot installations must be designed, prepared and operated before full-scale installations can be planned and costed with confidence. A standard design may never emerge since the choice of layout and process must take account of the character of the coal, the presence of faults, the thickness, depth and number of seams, and the existence of surface features such as buildings, railways, etc.

Ideally, all the gas would be brought up one large upcast throughout the life of the site, but a more likely situation is the simultaneous operation of a number of reactions each producing gas sufficient to generate about 250 kW, each upcast serving a limited number of reactions. The useful life of each reaction or set of reactions would probably not exceed a year and might be much less. The gas would either have to be carried across the site by pipeline for use in a central power station or if converted into electricity near to the upcast the power units would have to be relatively small (e.g. 1,000 kW) and mobile (e.g. on rails).

The kinds of layout or system which the trials begin to indicate as possible and economic may be illustrated in principle by three examples. A 40-acre section of coal seam on a site is shown in each case as being the area gasified in a single year of what might be a total period for the site of 20 to 30 years. Although there might be several seams able to be gasified the illustrations assume one only in operation. If the seam is 3ft thick the area shown will contain 200,000 tons of coal. If owing to faults, surface features and the limitations of the process only 35 per cent of the energy in the coal is brought to the surface in useful form the rate of gas production will be sufficient to generate 15 MW continuously. At any one time 40 reactions are operating. The situation indicated in each case is when nearly half the coal on the area illustrated has been gasified. Cost indications are based on a seam 400ft deep and the air requirements are assumed to be about 3 million cu ft/hr at 5 lb/sq in.

Fig. 5 illustrates a section of a possible system based on electro-linkage or high-pressure linkage, or a combination of the two. All preparatory work is done from the surface. The process as a whole is gradually moving from left to right, the spans on the left being exhausted, those in the centre are in operation while those on the right are being prepared. As spans become exhausted (some 12 weeks' operation) new spans are started up. Each span would be under independent control and the direction of flow reversed from time to time if necessary. Each span is assumed to be 50 yd long and the spacing between the parallel spans is 20 yd.

The preparatory work for this 12 months of operation involves drilling, casing and grouting some 200 boreholes which (at 25s per ft) would cost about £100,000. Linkage at 20s per ft would cost about £30,000. Running costs include air pumping (say £50,000), and wages, salaries, surface equipment, etc., which cannot yet be estimated. It should be noted, however, that these preparatory costs and those which follow for the other examples depend upon the length and spacing of the spans and other dimensions which in the event may have to be substantially different to the illustrations. They are, therefore, no final indication of the relative merits of the three hypothetical systems.

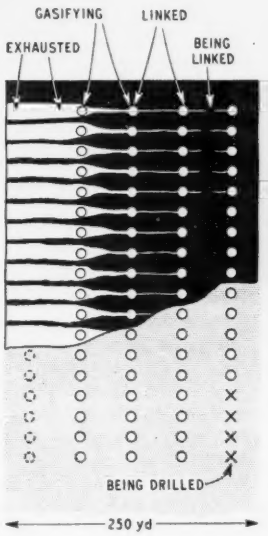


Fig. 5

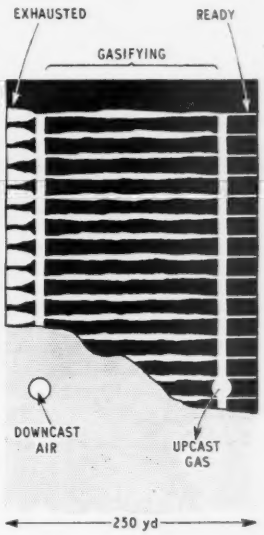


Fig. 6

The next example (Fig. 6) shows a section of a possible system based on directed drilling. In this section there are two shafts down to the coal and two galleries at coal level each 600 yd long and 200 yd apart. Parallel boreholes 15 yd apart connect from gallery to gallery. As before, the process as a whole is moving from left to right, the boreholes on the left being exhausted, those in the centre being in operation with reversals while those on the right are ready for operation when the centre ones are exhausted (about eleven months). Each span might have to be under independent control to enable the direction of flow in each to be reversed when necessary.

At £1 per yd the 10,000 yd of horizontal borehole would

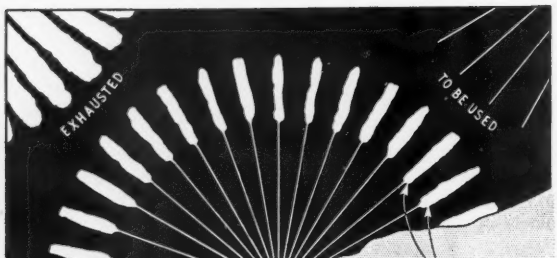


Fig. 7

cost £10,000. Each shaft and gallery will serve two sets of boreholes in succession so that the area shown need carry the cost of only 1¼ shafts and galleries. At £75 per ft for a 6ft diameter shaft the shaft cost is about £40,000. At £100 per yd for the galleries the gallery cost is about £80,000. Running costs should be much as in the previous example.

The final example (Fig. 7) shows a section of a possible system based on drilling blind boreholes. From each shaft there are drilled at coal level about 40 radial boreholes, each 200 yd long in the coal. Each borehole is fitted with a loose air supply tube to feed the reaction at the far end, the main air supply and gas exit being accommodated in the shaft. The drilling cost would be much as in the last example, £10,000 plus a further £10,000 for the air supply pipes and trunking. The shaft cost would also be about the same at about £40,000 but no galleries are required. The running costs should be much as before.

Fig. 8 shows an alternative form which could be used with advantage if the seam is wet (naturally or by reason of drilling flush) thus making gasification difficult in boreholes drilled down dip. The shaft cost is about doubled but the radial boreholes are drilled closer together leading in this pattern to the gasification of a higher proportion of the coal in the area. Only the tops of the two shafts are visible on the surface.

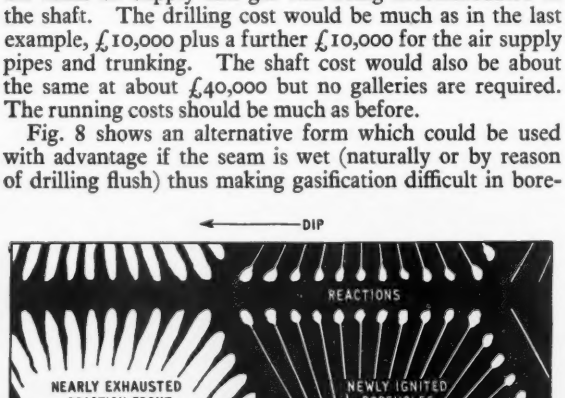


Fig. 8

Flue Gas Emissions

CHIMNEYS and the dispersal of smoke formed the subject of a paper presented by Messrs. J. E. Hawkins and G. Nonhebel before the Institute of Fuel on 9th November. Tall chimneys of modern power stations, the authors pointed out, were not required to create draught (which could be more cheaply provided by fans) but to improve dissipation of the gas by discharging it at a great height.

To discharge flue gas clear of down draughts, chimneys should be 2·5 times the height of the tallest adjacent building. At high wind speeds cool gas plumes could even then be brought down. Thus at the BEPO pile at Harwell the effective chimney height was 80 per cent at 38ft/sec and 50 per cent at 50ft/sec. Where a site proposed for a power station was in hilly country or close to a large tall structure, wind-tunnel tests on models provided an indication of the requisite chimney heights to discharge gases clear of down draughts, though the technique had not yet been developed for predicting the effect of the thermal buoyancy of gas on the dispersion of the plume.

To maintain a velocity of emission sufficient for keeping the plume at an adequate height at low loads, the single square chimney of Bankside (which had a gas washing system) was divided into four internal chimneys, two of which dealt with all the flue gas at half load.

The use of one instead of several chimneys increased the effective height of emission and so decreased ground-level concentration. When making plant extensions the use of one new chimney to carry all gases from both old and new plants might enable a fourfold increase in the discharge to be made but the ground-level concentration would go up by only 50 per cent.

The probable effect of gas washing, as indicated by the present state of knowledge, was in reduction of the average concentration of ground level over large areas remote from the chimney, but it might (particularly with the effluent processes used at Battersea and Bankside) lead to occasional puffs of moist concentrated flue gas at ground level near the chimney. The non-effluent process adopted at Fulham before the war achieved an efficiency of 97 per cent, which could be raised appreciably by application of later improved chemical engineering technique. Thermal buoyancy of the washed plumes was unlikely to exceed half that of an unwashed plume. Emission of fine dust was greatly lessened by gas washing.

Effluent processes could not be employed for inland power stations in view of restrictions on discharges into rivers. With a non-effluent process gases were cooled no further than their wet-bulb temperature, whereas with the other type they might be 40 deg C less.

Ground-level concentrations of sulphur-dioxide were compared with and without gas washing for a one-chimney power station burning 200 tons/hr of coal containing 1·5 per cent of sulphur. Assuming the washing plant of 97 per cent efficiency to lower the effective height of emission from 900ft to 300ft owing to loss of thermal buoyancy, and taking an average wind speed of 20ft/sec, the maximum ground-level concentration of SO_2 would only be reduced to one-quarter of its former value, although the amount of SO_2 emitted would be reduced 30 times, but the area over which the concentration was greater than 0·06 p.p.m. would be lessened about 200 times.

Measurement of Noise and Vibration

Developments at Pametrada

By A. G. THOMSON

MODERN practice in marine engineering is tending towards higher speeds and lighter machinery construction. The consequent higher stresses to which many parts of a marine engine are subjected increase their susceptibility to vibration fatigue failure. Research into noise and vibration produced by ships' main and auxiliary machinery is therefore an important part of the work of the Parsons and Marine Engineering Turbine Research and Development Association (Pametrada). This association was formed in 1944 to carry out research to improve and develop complete steam and gas turbine propulsion machinery installations. Its work on vibration is directed mainly to the development of machinery which is safer in this respect, but investigations are also undertaken to determine the causes of mechanical failure which sometimes occur during the operation of ships' machinery at sea.

Research in this comparatively new field of engineering has led inevitably to new measuring techniques and hence to the development of new measuring instruments, some of which are not available commercially. To meet this requirement special instruments have been designed and built in the electronics section of the Pametrada research station, Wallsend-on-Tyne. They are required to operate satisfactorily not only in the laboratory, but also in ships at sea under very much less favourable conditions. In recent years Pametrada has never failed to obtain measurements on board ship due to failure of electronic apparatus, despite the exceedingly rough handling which some pieces of equipment have occasionally received.

Some of the apparatus developed has proved useful to other trades and is readily available on a commercial basis.

Wave Analysers

In studying noise and vibration in machinery wave analysers are of great value. By isolating the components and measuring their magnitude, it is possible to pin-point the cause of rough running and thus save valuable time in locating the faulty item.

Practical wave analysers are electronic instruments belonging to either the indicating or tunable filter classes. An indicating (or heterodyne) analyser contains a filter tuned to a fixed frequency, signals of any other frequency being rejected. The complex signal being analysed has the frequency of all its components changed by an amount controlled by the tuning dial. Each component may, therefore, be made equal in frequency to the tune frequency of the filter, which is followed by a meter to read magnitude. A tunable filter (or degenerative) analyser contains a filter whose tune frequency is variable by means of the tuning dial, so arranged that at tune frequency the amplification is a fixed amount and at all other frequencies it is smaller (ideally zero). A meter measures the amplifier output.

Thus both classes of analyser have a calibrated dial to vary the frequency to which they respond and an indicating meter to show the magnitude of the selected component. Both require an electrical input which is the analogue of the mechanical effect being examined and both are used by tuning over the frequency range and noting each frequency at which the meter reads and the magnitude it shows.

The important difference between the two classes is that the output of the tunable filter analyser, which is available at an output terminal, is of the frequency shown on the tuning dial. This signal frequency output, which cannot be provided by heterodyne analysers, is vital if more refined methods of analysis are to be used, such as comparison of the selected component with some other signal. This is habitually done by using the Pametrada wave correlator to relate the frequency of the filtered component to the speeds of the shafts in a geared turbine installation.

The Muirhead-Pametrada wave analyser has been in commercial production for several years and is now well known. It was originally developed at Wallsend as a result of collaboration between Pametrada and Muirhead & Co., Ltd. Briefly, this instrument incorporates two analysers connected in cascade with ganged tuning controls, which possess a number of special features. An output meter and calibrated input attenuator are provided, together with output terminals and two sockets for telephone jacks. The frequency range covered is from 19 to 20,000 c/s.

Low-Frequency Measurements

For some purposes the lower limit of the Muirhead-Pametrada wave analyser is too high. A shaft rotating at 1,000 r.p.m., for example, has a fundamental frequency of about 17 c/s and much lower speeds are often encountered. Analysis at these low frequencies can be carried out by raising the frequency either by a fixed amount by means of heterodyning or by a fixed ratio by recording on tape and playing back at higher speed. Only the first method allows a live analysis to take place, and either subterfuge destroys the original signal.

For many purposes, therefore, it is necessary to use a low-frequency analyser. An instrument has been developed by Pametrada for use at very low frequencies, particularly in investigations on main shaft vibrations. It will analyse vibrations as low as 0·33 c/s, giving a good overlap with the existing instruments. A single Wien bridge degenerative amplifier is employed and the indicating meter gives full-scale deflection with a 1 millivolt r.m.s. signal applied to the input terminal. The selectivity factor, Q, may be switched to give values of 25, 10, 5 or zero. In the last condition the analyser acts as a low-frequency calibrated amplifier, which may be used to measure total noise or vibration.

Low-frequency instruments tend to be larger and heavier than their high-frequency counterparts mainly because large capacitors are required throughout. Difficulties in obtaining stability of the amplifiers increase complexity to a small extent and also tend to increase the size and weight of instruments. The alternating quantities involved have periods of a second or more and call for different techniques in development work and final calibration, since steady readings cannot be obtained on meters and oscillographs.

Another disadvantage is that the user finds the completed analyser much less convenient to handle. This is because a selective amplifier needs a finite time for the output to build up after the input is applied. In effect, the instrument must receive some minimum number of cycles of the signal before it can detect that a periodic signal of constant frequency has been applied. The greater the certainty the greater the number of cycles required. It can be shown that, in round figures, the build-up time of a simple tunable filter analyser is Q cycles of the tune

frequency. Thus with a selectivity, Q, of 25 at a frequency of 1 c/s the build-up time is 25 seconds and tuning becomes more tedious.

For analyses where further processing of the filtered signal is not required, it may therefore be more convenient to use the normal analyser and one of the two frequency changing methods previously mentioned. A tunable filter with its output at signal frequency is often required, however, in particular for use with a wave correlator, and the low-frequency analyser must then be employed.

Magnetic tape recording is a new technique which has recently been used to great advantage, particularly in ship-board trials where testing time is often limited. The recordings made on board ship can be brought back to the laboratory for detailed examination and analysis.

Automatic Analyser

An automatic analyser has been developed under Admiralty sponsorship to provide a rapid means of analysing complex frequencies, which have previously been recorded on magnetic tape, and recording the analysed frequencies on a waxed chart.

A portion of the recorded magnetic tape is formed into a loop and played back through a tape recorder using a Muirhead phonic motor as the drive. The phonic motor speed is increased smoothly over a 1 to 10 range so that the tape speed increases from 3 to 30 in/s, causing the frequency output from the tape to decrease over a 10 to 1 range. This derived output is fed to a Muirhead-Pametrada wave analyser set at a fixed frequency. An output from the analyser is obtained only when a recorded frequency on magnetic tape multiplied by the ratio of the instantaneous playback tape speed to the recorded tape speed is the same as the analyser setting. Thus a decade " scan " of the tape frequencies is obtained with the speed range.

Using three different analyser settings, the complete audio range can be covered in three decades, namely, 20-200 c/s, 200-2,000 c/s and 2,000-20,000 c/s. The analyser setting for each of the decades depends on the recorded tape speed. The analyser output is recorded on the moving chart of a Bruel and Kjaer logarithmic level recorder, which has as its axes decibels and frequency. The level recorder is fitted with a mechanical drive which is used to drive the oscillator controlling the speed of the phonic motor.

The frequency accuracy of the arrangement is extremely good and the level accuracy is in general within ± 1 dB, but is dependent on the original tape recording characteristics. The analysis is completed in a matter of minutes.

Rotor Balancing Instruments

Another instrument developed at Pametrada enables turbine rotors to be re-balanced in their own bearings on board ship, at low speeds. To do this, it is necessary to measure bearing pedestal vibrations caused by the unbalance forces and the phase angle of these forces with respect to some reference mark on the rotor.

The bearing pedestal vibrations are detected by a relative electromagnetic pick-up, activated not directly by the pedestal but by a tunable mass-spring system. This system can be tuned to resonate at the turbine rotor speed, about 500 r.p.m., so that vibrations at this frequency are magnified up to about 30 times above normal. The pick-up generates a voltage output proportioned to the velocity of the vibrations acting on it, so that its output consists almost entirely of the rotor speed frequency, and is in phase with the force causing the vibrations—in this case the out-of-balance force. This voltage is amplified in the instrument and registered on a meter calibrated in thousandths of an inch per second, thus indicating directly the r.m.s. value of the vibration velocity of the bearing pedestal.

The position of the out-of-balance resultant force at a particular bearing is found by measuring the phase angle of the voltage generated by the pick-up mounted on the bearing with respect to a reference voltage pulse, generated once per revolution. This pulse is generated by the passage of an impulse pin, used as a reference marker, on the shaft, past a small electromagnetic coil attached to the turbine casing. This phase angle is measured by the instrument and is indicated on a meter scaled 0-360 deg.

The instrument thus indicates the vibration velocity, proportional to the out-of-balance resultant force, and the position of this force round the shaft from the reference pin for a particular bearing pedestal. This information allows re-balancing to be accomplished to a precision similar to that obtained by a shop balancing machine.

Sound level meters, microphones and associated equipment used by Pametrada in the field and in its laboratories are calibrated in two test chambers—one for low and the other for high frequencies—over a range of frequencies and sound intensities similar to that pertaining to field work. Each chamber contains a loudspeaker driven from an oscillator, which is checked against standard frequencies, and an N.P.L. calibrated microphone is used to establish true sound levels at the position of the apparatus under test in the chamber. The chambers are lined with wedge-shaped blocks of glass wool. Sound falling on these wedges is absorbed and there is consequently no echo: in this way a high degree of uniformity of sound level is obtained.

The "BEAMA Catalogue"

THE third (1955-56) edition of the " BEAMA Catalogue " was published last week. This publication is now recognized as the most comprehensive buyers' guide of the products and services of the electrical manufacturing industry, and in its profusely illustrated 1,034 pages there are detailed descriptions of the products of the industry in more than 1,200 product groups. There is also a trade directory containing the names and addresses, etc., of member firms, with overseas representation, and a glossary in five languages—English, French, German, Portuguese and Spanish.

The three main sections are electrical power plant; electrical equipment in industry, transport and communications; domestic and commercial electrical appliances, lighting accessories and installations. For ease of reference each section is printed in a different colour. The catalogue is primarily intended to promote export trade and 15,000 copies of the new edition are being sent to every country in the world, to Embassies and Trade Commissioners, overseas buyers, public utility officials, distributors and wholesalers. It is published for the British Electrical and Allied Manufacturers' Association by Iliffe & Sons, Ltd., Dorset House, Stamford Street, London, S.E.1.

At a Press conference held in London last week to launch the new edition, Lord Chandos, president of B.E.A.M.A., said that the electrical industry was now the second largest exporting industry. He referred to the expanding overseas markets for electrical equipment and said that there was no sign of saturation. Speaking of the development of nuclear power, he said that this would tend to increase rather than lessen the exports of electrical machinery.

Sir Frank Lane, Permanent Secretary of the Board of Trade, said that the Catalogue was a notable contribution to the export effort and he paid tribute to the work of the B.E.A.M.A. which was outstanding among the trade organizations of this country in promoting the expansion of our export trade.

Pulverized Fuel Research

NEW EQUIPMENT AT IJMUIDEN EXPERIMENTAL STATION

LAST Saturday saw the inauguration of a new experimental furnace burning pulverized fuel at the experimental station of the International Flame Research Committee, situated in the works of the Royal Netherlands Blast Furnaces and Steelworks at Ijmuiden.

This experimental station originates from a decision by the Royal Netherlands Steelworks (KNHS) in 1947 to build an experimental furnace when they wished to change to oil firing in their steel furnaces. In this furnace oil flames were examined for their radiant properties to get maximum heat transmission in the steel furnaces. It was soon realized that similar problems occupied the British and French research institutes of the iron and steel industry and from mutual contacts the idea developed of doing the research jointly. To-day, associated in the work of the Committee, are such organizations as the British Coal Utilization Research Association, the Water Tube Boiler Makers' Association and the Central Electricity Authority.

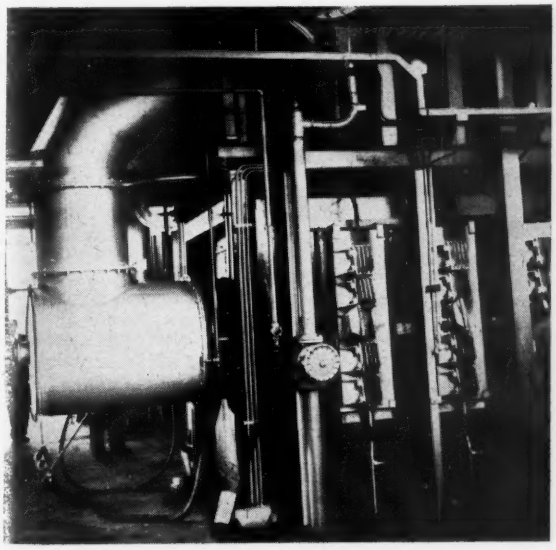
Soon after the International Organization for Flame Research had come into being the old furnace set up by the steelworks no longer satisfied the high demands of accuracy required and a new station was therefore built equipped with an oil and gas furnace, and put into operation in April, 1954. Since then the complete experimental station has been finished including facilities for pulverized fuel firing and for air pre-heating.

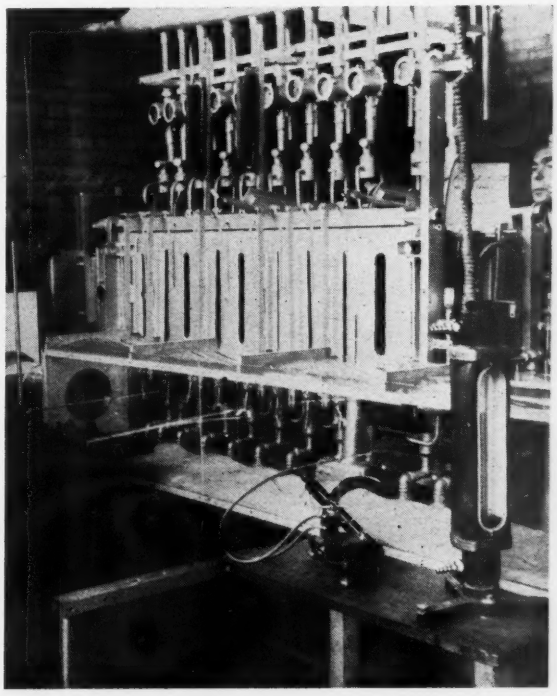
The two furnaces are placed side by side in the main part of the building, one end of which is occupied by an instrument room separated by glass partitioning which gives a central and open view of the two furnaces. Two auxiliary rooms cater for pumps, power distribution, etc., and on the opposite side of the building is a specially equipped gas analysis room. On one side of the building is a combustion air preheater designed for supplying hot air for use with either the pulverized fuel furnace or the oil and gas fired furnace: the preheater is fired by blast furnace gas and enables air to be heated to a maximum temperature of 750 deg C. The complete station, including all its auxiliary equipment and instrumentation, has cost about £70,000 and the yearly running cost is estimated at £20,000.

The furnace just completed for pulverized fuel firing has a cross-sectional area of 1·5 by 1·5 m and a length of 10 m. The average load of the furnace is of the order of 550 lb of coal per hour and by means of water cooled pipes, which can be introduced through holes in the roof, the thermal load of the furnace can easily be varied between 20 and 70 per cent of the thermal input. The furnace is also equipped with oil burning facilities for heating up purposes. The pulverizing plant and the furnace are able to make use of coals varying from anthracite to lignite with from 8 to 30 per cent ash content.

In the instrument room the facilities comprise a group of six electronic recorders and one indicator, used for recording all the electrical outputs obtained with the furnace, i.e. from radiation and suction pyrometers, thermo-couples in walls and roof, heat flow meters, etc. Three black body radiation furnaces are provided for calibration of radiation pyrometers, etc., and equipment is available for measuring velocity, temperature, gas analysis and soot concentration in the flame proper. To enable the mixing pattern of oil and fuel to be studied under widely varying conditions without actually using the

Right: A plexiglass furnace model for investigating fuel-air mixing. Behind is a geometrically correct model of the oil- and gas-fired furnace, used for flame tests under rapidly changing conditions. Below: Burner end of the new pulverized fuel furnace





furnace, a one-fifth scale plexi-glass model of each furnace is available making use of CO_2 or hot air as the burner fluid.

The station thus provides full facilities for doing a wide range of experiments on all types of flame, the two furnaces being well insulated, and able to withstand temperatures of 1,600 and 1,500 deg C respectively. Oil, gas, propane, pitch, coal, etc., can be used as fuel and combustion air preheated up to 750 deg C and if necessary enriched with oxygen is available. All the primary variables can be controlled as to pressure, temperature, flow, etc., and a range of universal recording instruments can measure temperature and radiation. The cost of setting up such facilities by any one organization on such a scale would be a considerable strain and there can be little doubt that this international research group is fulfilling a most important need. This is evidenced by the fact that many of the organizations now contributing to it have completely abandoned earlier research of their own and are relying on the results which it is hoped to obtain.

At the inauguration, the visitors from many countries were first addressed by Mr. A. H. Ingen Housz, chairman of the Royal Netherlands Steelworks, and then by Prof. G. M. Ribaud, president of the International Flame Research Committee. He explained that the trials carried out were of two kinds, performance trials and scientific trials. The first which were of an essentially practical nature had already borne fruit and improved efficiency had been obtained in many industrial furnaces through the use of more suitable burners and atomizing agents. Scientific trials involved a much more detailed study of the combustion of the flame itself and of the mechanism of combustion. He stressed the atmosphere of cordiality existing amongst the experimental teams which were composed of engineers of many nationalities from a variety of industries. Benefits of many kinds were being derived by these engineers, mostly young men, not only from the work they were doing but from their association.

Dr. D. T. A. Townend, director general of the British Coal Utilization Research Association, presented a paper on the combustion of solid fuels and the aims of flame radiation research in relation to the burning of pulverized coal.

He cited how important improvements in coal burning efficiency were to Britain where there was an increasing gap between coal production and the needs of expanding industry. At the present time about 17,000,000 tons of raw coal were burnt in suspension in Great Britain; this could be expected to rise to 30,000,000 tons by 1960, most of it in power stations. This trend was accelerated by the unit combination of boiler and turbine now accepted and by the increasingly low quality of the coal.

In referring to the research work specific to pulverized fuel combustion, he said that an important property of pulverized fuel in relation to large scale practice was the question of initial ignition and another important point on which knowledge was needed was the combustion mechanism of the residual coke in the pulverized fuel flame. He explained that the Ijmuiden approach was a compromise between tests with full scale industrial appliances in which it was difficult to secure uniform conditions and for which the cost of instrumentation was very great, and tests using small models where conditions were not representative of industrial practice. He stressed that the project did not merely embrace tests using the isolated furnace. They were backed by work with cold models as well as by theoretical studies by the staff at Ijmuiden, and this work was supported further by advice and help from a number of universities, etc., in different countries. He summed up the objectives as the securing of a better understanding of the principles of combustion and heat release from pulverized fuel, the extension of knowledge of the chemical reactions in solid fuel combustion, the enabling of the operational engineer or designer to predict more readily the effect of changes in operating conditions, and the developing of instruments and techniques. Dr. Townend also stressed the great value of interchange of viewpoints among the specialist technical personnel of the various countries.

Telecommunications Manufacturers

THE Postmaster General, Dr. Charles Hill, speaking at the dinner of the Telecommunications, Engineering and Manufacturing Association on 10th November, said that the Post Office was now in a position to tackle its telephone problems with increased resources. Nearly half a million new exchange connections would be made in 1956-57, and the rate would be rather over half a million during the two following years. There should be about eight million telephones in service in March, 1959, or double the number in 1946. About 200 new telephone buildings would be started in 1956-57, more than three-quarters of which would be exchanges. During the year ended 30th September last the Post Office had established an all time record for telephone installations with 436,000 new connections, as against 379,000 for the previous year. The trunk network had been further increased by more than 2,000 circuits since 1953, thus doubling the 1943 number.

Dr. Hill referred to the recently completed radio station at Rugby and said that in addition the Post Office was starting to build a chain of radio stations—a radio relay system—extending from south to north, through the centre of the country. When completed in about four years' time the chain would provide 1,200 telephone circuits and two television channels. It would have an ultimate capacity of several thousand telephone circuits and a number of television channels for the transmission of B.B.C. and I.T.A. programmes.

Trunk services had been speeded up by the extension of the system of direct dialling by operators to a subscriber on a distant exchange. The system would be extended to the whole country. Meanwhile the necessary equipment to enable subscribers to dial trunk calls themselves was being designed and the first would be ready in four years' time. Before long, he hoped, the Post Office and the industry would together be able to get down to the task of producing an all-electronic system.

Replying to the toast of "The Telephone Industry" proposed by the Postmaster General, Sir Harold Wernher, chairman of Ericsson Telephones, Ltd., said that manufacturers of telephone equipment welcomed the main proposals outlined in the recently published White Paper that the Post Office should revert to the recommendations of the Bridgeman Report of 1932 and adopt "self-contained finance." The proposal for a three-year plan was a big step forward because such a highly technical industry could not be run efficiently on a year-to-year basis. He pointed out that the telephone industry offered profitable, stable and interesting careers, and suggested that those leaving schools and universities should not pass it by without giving it very careful thought. There was no chance of stagnating in the telephone industry and the prospects were excellent for any young man.

The toast of the guests was proposed by Sir Thomas Spencer, vice-chairman of the Association, and replied to by Sir Robert Fraser, director general of the Independent Television Authority.

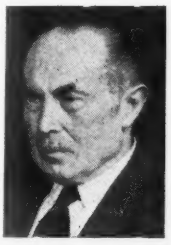
PERSONAL AND SOCIAL

News of Men and Women of the Industry

The Minister of Fuel and Power has appointed **Sir Giles Loder,** Bt., M.A., J.P., of Horsham, Sussex, to be a part-time member of the South Eastern Electricity Board.

We are very glad to hear from **Dame Caroline Haslett,** who has been ill for some time, that she is now making good progress. Dame Caroline asks us to express her thanks to all her friends in the industry who have written to her and she sends them her kindest regards.

The Illuminating Engineering Society has conferred honorary membership upon **Mr. H. C. Weston** in acknowledgment of his valuable services to the Society in many ways and over many years, and in recognition of outstanding contributions to knowledge of the important part played by good lighting in facilitating the activities of daily life. In presenting the certificate of honorary membership to Mr. Weston, at a meeting of the Society on 8th November, Mr. A. G. Higgins, the president, said that his work on the basis of the I.E.S. Code had been of inestimable value and had been accepted not only by the Society but by many other countries. He was recognized internationally as outstanding in the study of light and sight. He was president of the I.E.S. in 1945-46 and since then was honorary secretary until October of this year.



Mr. H. C. Weston

Mr. Weston is director of the Group for Research on Occupational Optics of the Medical Research Council. He is author of the book "Light, Sight and Efficiency"; he has written many papers dealing with light and vision and has presented papers not only in this country but in the United States and at various meetings of the International Commission on Illumination.

Mr. E. C. Presland, A.M.I.E.E., has been appointed works manager of the Willesden Transformer Co., Ltd. He joined the company in December, 1953, and was previously with the English Electric Co., Ltd.

Mr. D. G. A. Owen, B.Com., A.C.A., A.C.W.A., at present personal assistant to the Brush group controller of accounts, has been appointed company secretary of J. & H. McLaren, Ltd., as from 31st December next. **Mr. J. T. Rowlay,** A.C.A., the present secretary, is resigning his appointment as from that date at his own request to take up an appointment outside the Brush Group.

Mr. E. B. Foskett has been appointed manager of the Glasgow office of Honeywell-Brown, Ltd. Mr. Foskett goes to Glasgow after spending two years in the company's Sales Engineering Department. He succeeds Mr. D. J. Venning, who recently took up a senior appointment in the company's head office at Perivale, London.

Alderman J. W. Mitchell, J.P., of South Shields, a part-time member of the North Eastern Electricity Board, will retire from the Board on 31st December next on completion of his term of office.

Mr. A. W. Bunn, sales promotion manager of Hoover, Ltd., has completed twenty-five years' service with the company, and he has been presented with a gold watch to commemorate the event. The presentation was made by Mr. S. Roberts, managing director.

Mr. J. L. Florence, from health considerations, has relinquished his position as managing director of the Z Electric Lamp & Supplies Co., Ltd., but will remain on the board as a consultant director.

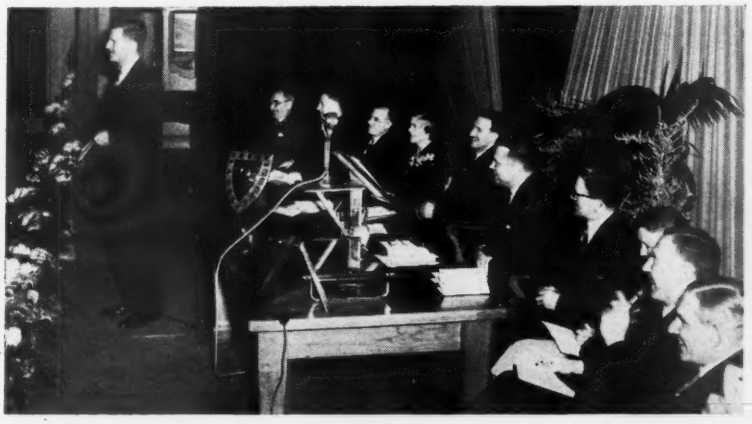
Mr. Norman E. Shephard, A.M.I.E.E., has been appointed chief of the Illuminating Engineering Department of H. W. Field & Son, Ltd., and he will be responsible for the designs of the company's lighting equipment. Mr. Shephard has recently been with B.T.H., and was previously with Ekco Ensign, Ltd. During the war he was with the Admiralty.

Mr. G. E. Bishop, A.M.I.E.E., who was formerly with Maintenance Contracts, Ltd., has been appointed southern area capacitor engineer to the Bryce Electric Construction Co., Ltd., in succession to the late Mr. F. Baker.

Mr. G. E. Bishop

The Yorkshire Factoring Co,. Ltd., has made the following appointments at its Doncaster branch:—**Mr. J. Russell,** who has been with the company for many years, becomes manager, Cycle Department, **Mr. R. Binns** becomes manager, Radio Department, leaving **Mr. G. Driver,** manager, Electrical Department, free to concentrate entirely on this side of the business.

Speaking at Stafford on 11th November to 700 young engineers training with the **English Electric Co., Ltd.,** Brigadier Sir John Hunt, C.B.E., D.S.O., D.C.L., LL.D., the Everest mountaineer, emphasized the importance of the young scientist and technician being master of the machine in the ultra-mechanical electronic world of to-morrow. The occasion was the annual apprentice



Brigadier Sir John Hunt addressing apprentices of the English Electric Co., Ltd. On the platform (left to right) are Mr. E. G. Carwardine, education superintendent, Stafford; Mr. A. Reader, works manager, Stafford; Mr. A. Torkington, principal, Stafford Technical College; Lady Hunt; Mr. J. R. Sully, general manager, Stafford; Mr. B. J. Tams, chief of education and personnel; Ald. H. H. Coghlan, Mayor of Stafford; Mrs. J. R. Fully; Mr. J. K. Brown, director of research; and Mr. J. M. Ferguson, chief engineer, Stafford

presentation held at the Borough Hall when awards and indentures are given to craft and student apprentices training at the Stafford Works. The 400 awards presented by Sir John take the form of vouchers which may be spent on books, tools or instruments. In addition, craft and student apprentices compete each year for the Stafford Shield. It was won this year by Mr. K. Frances, of Blaina, Monmouthshire, who is studying production development. A second shield, awarded annually by the work's foreman to the best craft apprentice of the year, was won by Mr. J. G. Beecham, of Howden, Yorkshire. Mr. Beecham is also top award winner of his year, and has now completed his training as a test engineer. The presentation of the foremen's shield was made by Mr. J. T. Gallear, foreman of switchgear sub-assembly at Stafford Works. At the presentation ceremony a vote of thanks to Sir John Hunt was moved by apprentice Mr. B. F. Hawksey, of Manchester, who is chairman of the Apprentice Association and himself one of this year's award winners.

There were over 500 members and guests at the annual dinner of the **Public Transport Association** which was held at Grosvenor House, London, on Thursday last week. The toast of the Association was proposed by Mr. J. A. Boyd-Carpenter, Minister of Transport and Civil Aviation, who referred to the great service which the member-companies of the Association rendered, particularly in rural areas. Paradoxically, the prosperity of the rural areas had had an adverse effect upon the transport system, and in many areas the services were

Electrical Industries Ball

As usual, the annual dinner and ball of the Electrical Industries Benevolent Association held last Friday at Grosvenor House, London, W.1, was a very successful affair. The 1,100 or more people who participated were greeted on arrival by the president, Sir Harold Bishop, and Lady Bishop. Many familiar faces from all branches of the electrical industry and profession were seen and some veterans displayed remarkable agility on the dance floor.

After dinner, Sir Harold Bishop announced that the customary telegram of loyal greetings had been sent to the Queen (the Association's patroness) and read the reply which had been received. He reminded those present that this was the golden jubilee of the Association which had arisen from a gathering of about half-a-dozen people who had decided to do something for the unfortunates of the industry. Sir Harold said that the usual collection would be made and asked for generous support.

Dance music was provided by Geraldo's Embassy Orchestra and during an interval between dances a cabaret show was presented by Barbour Brothers and Jean (stilt walkers), the Trio Morlidor (contortion act) and Ravic and Babs (roller skaters). Over forty prizes, given by firms and individuals, were presented during the evening.

The sale of programmes (provided by the British Thomson-Houston Co., Ltd.) realized £569 and the collection amounted to £266; altogether the Association's funds will benefit to the extent of over £1,700.

1. Sir John and Lady Dalton being greeted by the President (Sir Harold Bishop) and Lady Bishop. 2. Mr. and Mrs. V. C. H. Creer's party. 3. The electrical wholesalers' party including Mr. and Mrs. A. B. Wildsmith, Mr. and Mrs. R. E. Silvey, Mr. and Mrs. W. H. Swain and Mr. and Mrs. J. D. Read. 4. The President's table. 5. This group includes Mr. C. R. King, Mr. J. Mortimer Hawkins and their ladies. 6. At this table were Mr. and Mrs. C. B. Cleland, Mr. and Mrs. W. M. York, Mr. and Mrs. R. D. W. Bowtle, Mr. and Mrs. R. D. Chinn, Mr. and Mrs. T. C. F. Bigland, Mr. H. Hunt and Dr. J. Bullough

unremunerative. It was, however, essential that they should be maintained for the benefit of those who had no other means of transport. The Minister referred to the inadequacy of the public highways, and said the Government was starting on a substantial programme of road improvement.

Mr. J. M. Birch, chairman of the Association, in reply, said that the bus and coach industry was beset with such difficulties that it was becoming increasingly hard to maintain the efficient network of services which had been developed throughout the country during the past half-century. Successive Governments had been largely responsible for creating the present dangerous situation by their neglect to provide a road system adequate to the country's needs and their imposition of a heavy and unfair burden of taxation by way of fuel tax and excise duty. Mr. Birch referred to the fact that the Minister had indicated that he was prepared to amend the regulations to permit the operation of 30ft long double-deck vehicles on two axles, and said that had the relaxations in relation to length and width of single- and double-deck vehicles been granted years ago, the operators of the services would have been in a better economic position to-day to cater for peak traffic and rural services. He urged that the speed limit laid down should be raised so that public service vehicles could move with the general stream of traffic.

Mr. Birch also proposed the toast of the guests, and Lord Mancroft responded in a brilliantly witty speech.

Mr. G. G. Cooper, A.M.I.Mech.E., A.M.I.E.E., previously shift charge engineer at Barking "C" power station, has been appointed deputy superintendent of Newton Abbot power station, South Western Division, C.E.A.

Mr. M. G. Lane, M.I.Prod.E., production manager of Hoover (Washing Machines), Ltd., Merthyr Tydfil, has completed twenty-five years' service with Hoover, Ltd., and he has been presented with a gold watch by Mr. S. Roberts, managing director.

Mr. H. L. Perry, Graduate I.E.E., who has been connected with the cable industry for some years, has now joined the Cable Division of Connollys (Blackley), Ltd., as southern area representative, operating from the London office. His selling activities will also include "Blackley" tape.

Mr. P. J. A. Lubbock, who has been technical writer and publicity officer to Chaseside Engineering Co., Ltd., for the past six years, has now left the company to take up a new appointment as publicity officer to Langley Alloys, Ltd.

Mr. W. R. Jones has retired from the position of Midlands area manager to Murex Welding Processes, Ltd. Mr. Jones joined Alloy Welding Processes, Ltd., twenty-nine years ago and went to Birmingham at the time of the amalgamation of the company with Murex Welding Processes, Ltd. He held the position of area manager for twenty-five years. He was a founder member of the Committee of the Institute of Welding, Birmingham Branch, and was chairman in 1938-39 and later again served on the Committee. Mr. Jones will be succeeded as Midlands area manager by **Mr. A. T. Willmouth,** formerly area manager of the East Midlands.

Mr. Carmel Cuschieri, a teacher of technical subjects in Government schools in Malta, is in the United Kingdom until March on a six months' British Council bursary to study the organization of vocational and trade training centres and schools at the College of Technology and Commerce, Leicester. Before becoming a teacher Mr. Cuschieri was electrical engineer in the main central generating station

7. Mr. M. R. Neville's party. 8. Mr. H. Senior Fothergill (secretary, E.I.B.A.) and Mr. and Mrs. C. R. King with the President and Lady Bishop. 9. Mr. S. C. Hurry and guests. 10. Mr. and Mrs. R. A. Marryat and party. 11. This group includes Mr. and Mrs. O. W. Humphreys and Mr. A. E. Page. 12. Sir John Hacking, Mr. E. A. Mills and Mr. L. Drucquer are at this table

in Malta. His responsibilities were later widened to include the maintenance and operation of all electrically operated water supply pumping stations.

The annual dinner of the **J. & P. Foremen's Association** was held at Woolwich on 28th October when Mr. S. Simmons (chairman of the Association) proposed the toast of the company. Mr. G. Leslie Wates, J.P., Comp.I.E.E., chairman and joint managing director, in his reply thanked the foremen for their loyalty. He stated that a considerable amount of money had been invested in the New Cross factory, taken over as derelict and now partly in production. Also as a result of recent rebuilding they now had a paper cable factory. He stressed that the company was facing keener competition than ever before, both at home and abroad, and it must be expected that profits would be smaller. Mr. C. W. Bishop, chief buyer, proposed the toast of the Foremen's Association, which was replied to by an ex-J. & P. foreman, Mr. H. Swan. Mr. F. Crichton, secretary of the Association, proposed the guests and said they had received a telegram from Mr. W. Glass, joint managing director, who was unable to attend owing to ill-health, to which they had replied wishing him a quick return to better health. Mr. J. N. Dean, chairman of Telcon, was also indisposed, but they welcomed Dr. E. W. Smith, a co-director, and managers and foremen of that company. Mr. C. F. Lovell replied, and a smoking concert followed.

A call to implement the Fair Trading Policy and not merely to pay it lip-service, was made by Mr. J. Mortimer-Hawkins, chairman of the London Branch of the **Electrical Contractors' Association,** at its dinner-dance at Grosvenor House on 4th November. Replying to the toast, the president of the Association, Mr. R. A. Marryat, supported the chairman's remarks and expressed his great pleasure at attending the dinner-dance of his own branch while holding his present office. About 350 guests, members, their wives and friends, attended the dinner. They included the director and secretary of the Association, Mr. L. C. Penwill, the chairman of the London and Home Counties Sectional Board, Mr. C. J. Veness, and members of the Electrical Contractors' Association Council. Guests danced to Stanley Blomfield's orchestra and enjoyed a cabaret given by Barry Mannings.

The **United Kingdom Atomic Energy Authority** has announced that a delegation was to leave London Airport on Tuesday on a six-day visit to Russia. Sir John Cockcroft, F.R.S., director of the Atomic Energy Research Establishment, Harwell, who was invited to make this visit by the Russian delegation at the United Nations conference at Geneva last August, will not be able to take part because of his commitments in the United Kingdom. In his absence the delegation is being led by his deputy, Dr. B. F. J. Schonland, F.R.S. The other names announced by the Authority are: Dr. Willis Jackson, F.R.S., representing the Royal Society and the British Nuclear Energy Conference, Mr. B. L. Goodlet, head of Engineering Research and Development Division, Atomic Energy Research Establishment, Dr. J. V. Dunworth, head of Reactor Physics Division, A.E.R.E., Dr. D. W. Fry, head of General Physics Division, A.E.R.E., Mr. A. A. Smales, head of Analytical Chemistry Group, A.E.R.E., Dr. L. Rotherham, head of research and development, Industrial Group, Atomic Energy Authority, and Mr. J. C. C. Stewart, director of technical policy, Industrial Group, Atomic Energy Authority.

OBITUARY

Mr. A. H. Short.—The death has occurred at the age of sixty-one of Mr. Arthur Henry Short, M.I.E.E., district manager at Minehead of the South Western Electricity Board. During the 1914-18 war he was employed by the Nobels Explosives Co., Ltd., as station charge engineer and went to the West Country in 1922 when he was appointed engineer and manager of the Burnham & District Electric Supply Co., Ltd. Two years later he joined the Minehead Electric Supply Co., Ltd., as engineer and manager and when, in 1937, the Whitehall Securities Corporation acquired an interest in that company, Mr. Short also took over control of the Wellington Electric Supply Co., Ltd. On nationalization, Mr. Short was appointed manager of the Minehead District in the Taunton Sub-Area. He leaves a widow and a son, Mr. R. E. Short, who is with the South Western Electricity Board in Bristol.

Mr. J. B. Pearson.—The death has occurred at the age of seventy-three of Mr. John Barrington Pearson, of Wetheral (Cumberland), retired chairman and managing director of Cowans Sheldon & Co., Ltd.

Mr. John Ashton Henry, a lecturer in electrical engineering at the Bradford Technical College, died recently at the age of twenty-nine. He was a graduate of the Institution of Electrical Engineers.

Mr. E. A. Barton, chief buyer of the E.M.B. Co., Ltd., West Bromwich, for the past thirty-five years, died suddenly on 9th November.

Mr. W. E. Jewell, who had served Falk, Stadelmann & Co., Ltd., for over fifty-two years, becoming manager of the Contracts Department, died at Brighton on 29th October, aged 78 years. He retired from Falks in March, 1948.

Mr. Allan Charles Campbell, A.M.I.E.E., of South Croydon, died on 31st October at the age of ninety-two.

I.E.E. Centre Dinner

About 160 members and guests attended the annual dinner on Monday last of the Merseyside and North Wales Centre of the Institution of Electrical Engineers, held at the Grosvenor Hotel, Chester. This was the first time the event had occurred in Chester, but applications for tickets were greater than ever before.

The toast of the Institution was proposed by Mr. P. T. Fletcher, deputy director of engineering of the Industrial Group, United Kingdom Atomic Energy Authority. He spoke of the way nuclear engineering was drawing together engineers of every type in ways not hitherto experienced. This had led to the formation of the British Nuclear Energy Conference. The growth of nuclear power would have a considerable impact on the operating and control methods of Great Britain's electrical network.

He felt that nuclear power stations would in the future be built on a one-contract system, which would also be beneficial in the export market. The role of the Atomic Energy Authority now was that of leading the way and demonstrating which road to take to the supply authorities and industry. He indicated that they might soon embark on another and more advanced type of station. Referring to the use of enriched uranium 235 in reactors he explained that while the United States had abundant supplies of this, produced with cheap hydro-electric power, we had to use large quantities of power to produce it from natural uranium. To then use it for power production was hardly sensible; it was better to use natural uranium in the first place as we were doing. U235 would, however, be important in the construction of more portable reactors.

Sir Hamish McLaren, Director of Electrical Engineering, Admiralty, and a vice-president of the I.E.E., in his reply, referred to the part played by the Institution in the formation of the British Nuclear Energy Conference. He saw signs of the development of reactor engineers as a class and hoped they would find a home among the recognized institutions where they would be welcomed. He approved the recent action of a group of industrialists in setting up a fund to assist scientific education in the independent schools. In the past the engineering industry had had less than its share of the talent from this source.

The toast of the guests was proposed by Mr. T. Coates, past-chairman of the Centre, and the headmaster of King's School, Chester, the Rev. L. F. Harvey, made a most felicitous reply.

VIEWS on the NEWS

By REFLECTOR

AN excellent example of enterprise in water heating development is reported from Warrington. Most of the new council houses in the town are already plumbed and wired for immersion heaters and Mr. D. St. C. Barrie, the district commercial officer of the Merseyside and North Wales Electricity Board, decided to carry out an experiment to see how many of the tenants were interested in the installation of such heaters. A "task force" was organized consisting of sales representatives, electricians and a foreman of stores so that as soon as an order was obtained the work could be put in hand immediately. Because both the husband and wife might be out at work during the day, the calls did not start until after 5 o'clock. In only five evenings some 53 immersion heaters were installed, or approximately 10 per cent of the total number of calls made. I understand that Mr. Barrie is well satisfied with the experiment and hopes to repeat it in the New Year. In view of the importance of the water heating load other Boards may wish to take similar action.

* * *

The effects on health of diesel fumes continue to be discussed in the correspondence columns of the *Daily Telegraph*. In defence of the diesel engine, Mr. M. Logan, director of the British Internal Combustion Engine Manufacturers' Association, on Monday pointed out that a study of the incidence of casualties in the London "smog" of a few years ago would show that they bore less relation to industrial areas or traffic concentrations than to population density and from this he reasons that the domestic fire must bear a heavy responsibility as a polluter of the atmosphere. With this I am in full agreement, although as another correspondent observed, the domestic fire at least discharges its fumes in the air whereas buses, lorries, etc., do so "practically into the faces of pedestrians and small car users." For myself, I would like to see less use made of both, electric fires taking the place of the wasteful coal fire and trolley-buses providing urban transport instead of diesel buses. In view of the present economic situation coupled with the clean air drive, surely the carrying out of London Transport's costly programme of changing over its trolley-bus services is completely unrealistic?

* * *

A new approach to the cure of stammering is suggested as a result of recent experiments. In a letter published in the 5th November issue of *Nature*, Dr. E. Colin Cherry, of the Department of Electrical Engineering at the City and Guilds College, who is well known for his researches in the field of communications, together with Mr. B. McA. Sayers, of the same Department, and Mrs. Pauline M. Marland, a speech therapist, report that the experiments have clearly shown that stammering is caused not by motor but by perceptual faults and that under certain conditions of external control those who suffer in this way can be induced to speak fluently. By applying a very loud tone through headphones to the ears of the subject (a frequency of about 150 c/s was found most effective) the stammerer's perception of his voice sounds was interfered with and it was found that in 24 cases out of 25 a remarkable improvement was obtained. The exception was the only individual who normally worked in noisy surroundings.

* * *

Keeping butter at the correct temperature and hardness has for some time exercised the ingenuity of manufacturers. Nowadays, many of them are introducing a special compartment in the door of a refrigerator in which the temperature is somewhat higher than that of the main storage space. In one American-made machine I saw recently, however, the matter has been taken a stage further and a heating element has actually been incorporated in the compartment. This seems to me to be carrying things a bit far, for why it should be thought necessary to keep the butter in a refrigerator at all in cold weather unless no other food storage space is available I fail to see. The next thing we shall be having cookers with a refrigerated compartment for people who prefer their roasted joints cold.

* * *

According to the *Leamington Spa Courier*, the Harbury Parish Council are to own their lighting equipment; "in fact they have no option." They have been told that if the Council refused to buy the equipment for £177, East Midlands Electricity Board could dismantle the 43 lights in the village and leave it in darkness. I can appreciate the Board's not wanting the responsibility of outlying lighting systems but does not its action savour of "lightmail"?

* * *

The *Electrical Review* has always been outspoken in its condemnation of "amateur" wiring installations. Although some deplorable examples are still to be found, I like to think that we have advanced some way since the following caustic comments appeared in the journal's issue of 15th November, 1895:—

> "Cheap Wiring.—There are many ways of cheapening the introduction of electric lighting. We illustrate one. For the benefit of those interested in cheap wiring, we would say that you simply take two wires, twist them together, tie one end to the street mains and then run them through the building, metal staples being used as support, till you arrive at the lamps when you merely fix them on. Our illustration represents the actual wiring in a north country office. No casing is used at all. In some of the rooms the wires are allowed to droop, and no doubt if these were carefully garnished with ham frills they would make graceful festoons. Yet we have fire offices and an institution which are putting themselves in considerable pain to devise rules for wiring."

INDUSTRIAL NEWS

Atom Exhibit at B.I.F.

The "Atoms for Britain" exhibit, which was staged by the U.K. Atomic Energy Authority at the Conference on the Peaceful Uses of Atomic Energy in Geneva in August, is to be repeated at next year's British Industries Fair in London. The exhibit, which covers some 7,000 sq ft, shows Great Britain's progress in harnessing nuclear power and in using atomic energy in industry, agriculture and medicine. The research carried out at Harwell will be illustrated by large-scale models, photographs and diagrams. One of the models will be of DIDO, the "heavy-water" research reactor which will be completed by next summer. Other items will be a model of the atomic power station now being built at Calder Hall, the first of twelve to be built in Britain during the next ten years, and a model of the power unit now under construction at Dounreay, Caithness.

Snowy Mountains Project Contracts

A *Reuter* message from Cooma, N.S.W., reports that at a conference of the Commonwealth Press Union on 10th November, Sir William Hudson, commissioner of the Snowy Mountains Hydro-Electric Authority, stated that not one British tender had been received for the civil engineering contracts amounting to £24 million. He said that the Authority owed a great deal of gratitude to the United States. Much work had been done by United States contractors on an actual cost basis. A number of civil engineering contracts had been met by Italy, Norway and France in addition to the United States.

According to the *Daily Telegraph*, an official at Australia House, London, said that the Snowy Mountains contracts were actually placed in April last year. The designs had been prepared by the United States Bureau of Reclamation and it was a type of work carried out by Americans elsewhere. British contractors may have felt the work was "tailor-made" for an American company. British electrical contractors said that Sir William's remarks did not apply to them. Australia was an immense market for British equipment, and they tendered whenever they got the chance. Civil engineering concerns say that there were many reasons why they might not tender. Distance would be a major factor at a time when they were fully occupied with works in Britain.

Sound Applications in Industry

The next exhibition in the industrial showroom, Chester Street, Birmingham, of the Midlands Electricity Board, will be "Sound Applications in Industry and Commerce," held in conjunction with Pamphonic Reproducers, Ltd., and other manufacturers. It will be held from 21st to 25th November.

Lighting Showrooms

Last week saw the official opening of the new lighting fitting showrooms of Dernier & Hamlyn, Ltd., at the company's premises at 23, Newman Street, London, W.1, and to mark the occasion over 200 of their friends in the trade, including architects, contractors and wholesalers, were invited to an "at home" on Wednesday evening, 9th November.

Occupying a floor area of more than 1,000 sq ft, the showrooms display a comprehensive range of the company's lighting fittings, including many fine examples of period fittings of a type that the company has been noted for since it first commenced business over sixty years ago. Contemporary fittings, wall lights, desk lamps and a large selection of lampshades are also to be seen. All the fittings are independently switched and the total loading is in the region of 20 kW.

General view of the new Dernier & Hamlyn lighting showrooms

Transformers for the United States

It is reported that the English Electric Export & Trading Co., Ltd., has been awarded the contract for distribution transformers for the Minidoka reclamation scheme in Idaho. The amount is £37,875. The United States Department of the Interior has announced new rules in awarding contracts. These call for the addition of 6 per cent to any foreign bid to cover possible price adjustments, import duty and transport costs from port of entry. A further 6 per cent would be added to foreign bids when competitive equipment is manufactured in an American area certified as having substantial unemployment.

Prices of Materials

In the accompanying table we give the basis prices of the more important materials used in the electrical industry. The figures given are the selling prices and are those quoted on Tuesday last.

ALUMINIUM Ingots	ton £171 0s 0d
COPPER, H.C. Electro	ton £379 0s 0d
Fire Refined 99·70%	ton £377 0s 0d
Fire Refined 99·50%	ton £376 0s 0d
COPPER Tubes ..	lb 3s 6½d
Sheet	ton £434 0s 0d
H.C. wire and strip ..	ton £410 15s 0d
LEAD, English ..	ton £107 5s 0d
Foreign	ton £106 0s 0d
MERCURY	flask £90 10s 0d
TIN, block (English) ..	ton £775 0s 0d
ZINC, G.O.B. Foreign	ton £92 0s 0d
Electrolytic	ton —
BRASS Tubes (solid drawn)	lb 2s 9¾d
Sheet	ton £342 5s 0d
Wire	lb 3s 4¼d
PHOSPHOR BRONZE Wire	lb 5s 1½d
PLATINUM	oz £32 10s 0d
RUBBER, No. 1 R.S.S. spot	lb 37½d—38d

B.B.C. Handbook

The 1956 edition of the B.B.C. Handbook is a guide to the organization and work of the B.B.C. with up-to-date statistics about the Corporation. Among the many matters covered are the economics of broadcasting and details about transmitting stations, wavelengths and studios and problems of reception. An article describes the Corporation's plans for bringing v.h.f. broadcasting to Scot-

land, Wales and Northern Ireland and extending its operation in England. The Handbook is published by the Corporation, Broadcasting House, London, W.1, price 5s.

New B.T.H. Factory at Leicester

Recent statements reported in the Press regarding the new B.T.H. electronics factory at Braunstone Aerodrome, have given the number of people to be employed there as between 2,000 and 3,000. The company states that these figures are greatly exaggerated and the true facts are that initially when the factory is ready, the labour force required will be of the order of 350 to 450, of which a proportion will consist of physicists, technical engineers, draughtsmen, etc., already in the company's employ. Ultimately it is expected that the factory will employ approximately 750. These will comprise 550 males and 200 females.

Aluminium in Building

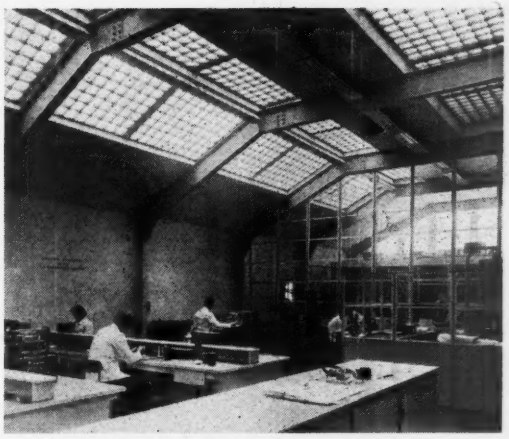
An exhibition, Aluminium in Building, was opened by Mr. J. R. Bevins, M.P., Parliamentary Secretary, Ministry of Works, at the Building Centre, 26, Store Street, London, W.C.1, on 8th November. The exhibition will remain open until 30th November.

Reading Technical College

The Reading Technical College, which was opened by the Queen Mother on 20th October, contains a complete Hotpoint home laundry in the Department of Domestic and Women's Trades Subjects.

Demonstration Train

A demonstration train, prepared by Lansing Bagnall, Ltd., Basingstoke, is to make a tour of Great Britain. Representatives of prominent industrial organizations, the Services and local dignitaries are being invited at each town to see this demonstration. Mr. Derek Walker-Smith, Q.C., Parliamentary Secretary to the Board of Trade, speaking at Paddington recently where the train's tour began, welcomed the exhibition. The train consists of eleven trucks and carriages and has been equipped with a special cinema to hold some sixty people, a conference and reception coach, seven standard box cars and an end-loading pallet van. Fork-lift trucks, pallet and stillage trucks, tractors and trailers are shown moving, stacking and storing a wide variety of typical loads in conditions simulating the confined spaces pravalent in many factories and warehouses. The exhibition train will visit Bristol, Cardiff, Liverpool, Manchester, Glasgow, Newcastle, Leeds, Hull, Sheffield, Nottingham and Birmingham.



Interior of R. B. Pullin's new air-conditioned workshops

Sales Conference

Over 150 members of the staff of the Simplex Electric Co., Ltd., attended the Simplex-Creda sales conference held at Ashorne Hill, Warwickshire, from Thursday, 3rd November, to Sunday, 6th November. Addresses were given by Messrs. S. Farrer, E. G. Plucknett, J. D. Johnson, and other senior executives of the company on the company's organization and development and on its sales policy. A novel feature was an address by the chief purchasing officer on "The Buyer's Reaction to the Salesman." Methods of selling at home and in the export market were explored and discussed on all the company's products. Throughout the four-day conference the chair was taken by Mr. E. G. Plucknett.

Dust-free Instrument Manufacture

A new building has just been completed by R. B. Pullin & Co., Ltd., at their works on the Great West Road, Brentford, Middlesex. It has been designed to provide conditions which are dust-free and otherwise ideal for the assembly and testing of gyroscopic and other precision instruments. It will also cater for special processes, such as lens blooming, in which a very high degree of cleanliness is essential.

The building is pressurized and fitted with air locks, so as to prevent the entry of dust through openings in the structure. All incoming air is heated after passing through a viscous type filter, automatically cleaned in an oil bath. Air enters the working space through ducts and nozzles in the roof, and is withdrawn through vents at floor level. Ten changes of air are circulated every hour, and any desired proportion of this air can be filtered and recirculated. When work is not in progress, the air conditioning system can be shut down and an even temperature of 65 deg F maintained by a hot water radiator system. Hot water for the air conditioning and radiator systems is obtained from a gas-fired boiler.

A high and even intensity of shadowless illumination is essential for this type of work and this requirement is met by the daylight admitted through the concrete and glass pavement lights mounted in the ceiling, and by an installation of continuous trough fluorescent lighting fittings.

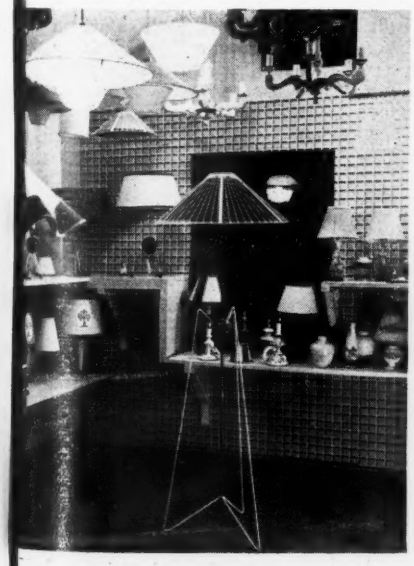
Nigerian Contracts

A Nigerian Government Notice (No. 1200) reproduced in the *Nigeria Trade Journal* announces that only building, civil engineering and electrical engineering contractors whose names are in the Federal Works Register of Contractors are eligible to be invited to tender for Federal public works contracts to a value of more than £500. Registered contractors are to be classified into categories according to their capacity, expressed in contract values; these classes range from £501-£3,000 to over £100,000.

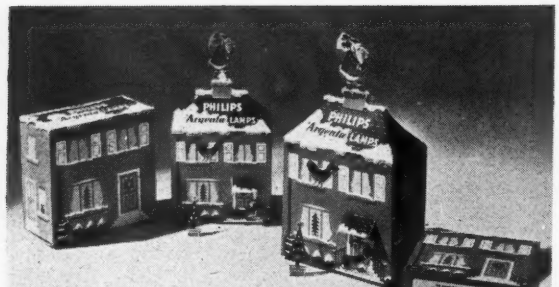
The necessary forms for registration can be obtained from the Federal Works Registration Board, Public Works Department, Lagos, Nigeria.

Christmas Sales Aids

A seasonable version of the current "Philishave" poster and a special Christmas pack for "Argenta" lamps have been produced by Philips Electrical, Ltd., for the Christmas trade. The revised "Philishave" poster has been silk-screen overlaid with a Christmas theme and will be exhibited at selected sites on London and Glasgow underground stations. A 15in × 10in version, printed litho in



Part of the new lighting fittings showroom opened by Bushell & Saward, Ltd., at 11-13, Baron Street, London, N.1



Christmas "Argenta" lamp packs of Philips Electrical, Ltd.

seven colours and spot-gummed at each corner, will also be available for dealer display. The "Argenta" pack, finished in seven bright colours, is in the shape of a house and when empty forms a novel attraction for the children. The pack is made in two sizes: two 60 W and two 100 W lamps.

Rolling Mill Equipment for Australia

The British Thomson-Houston Co., Ltd., Rugby, has received through its associated company, Australian Electrical Industries Pty., Ltd., an order worth approximately £400,000 for the Broken Hill Proprietary Co., Ltd., Australia. This covers the electrical driving equipment for an 18in continuous steel strip and skelp rolling mill to be installed at the Broken Hill Proprietary Co.'s Newcastle Works, New South Wales. The plant includes fourteen d.c. motors totalling 9,800 h.p., and two 3,500 kW banks of grid controlled mercury arc rectifiers for supplying electric power to the motors, together with control gear.

Radar for Chilean Warships

A contract worth more than £250,000 has been awarded to Marconi's Wireless Telegraph Co., Ltd., for the complete radar and communications equipment for two destroyers now under construction by Vickers-Armstrongs, Ltd. These warships, which are being built for the Chilean Government, will be among the most modern of their class.

Gauge and Tool Makers

The annual report of the Gauge and Tool Makers' Association, to be presented at the annual meeting on 16th November, states that membership again increased and now stands at 320 firms. Close contact was maintained with the various Government Departments and with other trade organizations. As a result of the Export Committee's activities in consultation with the Board of Trade, all bilateral trade agreements initiated or renewed by Great Britain now include separate and adequate quotas for the export of British tools and gauges. In August-September last the fifth competition in craftsmanship and draughtsmanship for apprentices and learners was held. Nine applications for the Association's certificate of craftsmanship were accepted by the Council, which has accepted a recommendation from the Education and Apprenticeship Committee that the Association should award a certificate of gauge and tool design and draughtsmanship as an incentive for young men. References are also made in the report to the sixth edition of the Handbook and Buyers' Guide issued at the beginning of this year, and some of the services rendered by the Association to its members.

Antarctic Expedition

Enfield Cables, Ltd., informs us that its cables are to be used by the Commonwealth Trans-Antarctic Expedition which sailed from the London Docks for the South on Monday last. The cables will be used for receiving and transmitting radio reports; as part of the beacon installation for guiding supplying aircraft; on various meteorological instruments; in the mobile workshop for on-the-spot repairs; and as an essential link in the mobile lighting systems in the various camps.

To meet the exacting conditions the company has used a plastic insulation which will remain flexible and, unlike other materials, will not become brittle at sub-zero temperatures.

Wolf Electric Tools, Ltd., is supplying all the electric tools and associated accessories for the expedition. These include portable drills, a double ended bench grinder and a wide range of accessories such as drill stands, machine bits, holesaws, grinding wheels, etc., and a range of Wolf electric soldering irons.

Four 7½ kVA alternators manufactured by Brush Electrical Engineering Co., Ltd., will be used by the expedition. The electricity generated will be used for radio communications, general lighting, and a washing machine.

E.C.C. Sales Conference

A sales conference was held at Bushbury Engineering Works, Wolverhampton, on 3rd and 4th November, when representatives from home district offices of the Electric Construction Co., Ltd., joined with directors and works sales and production staff to discuss sales and technical questions regarding the company's products. The district engineers and members of the executive staff attended a reception given by the chairman and the managing director, and at the conclusion of the conference, the district engineers joined the staff annual dinner and reunion held at the Wulfrun Hall, Wolverhampton. The toast of the company was proposed by Mr. J. H. Charnley (Manchester office) and replied to jointly by Mr. Charles Reid (chairman) and Mr. J. C. Milne (managing director). The toast of the staff was proposed by Mr. J. Johnson Smith (London) and replied to by Mr. James Anderson (machine design).

British Railways Experts' Dutch Visit

At the invitation of Mr. F. Q. den Hollander, president of the Netherlands Railways and member of the British Transport Commission's Technical Development and Research Committee, a party of ten senior British Railways officials spent three days this week examining diesel and electric rail services in Holland.

The party, which was led by Mr. J. Ratter, technical adviser to the B.T.C., visited the diesel shed at Utrecht and inspected various types of diesel and electric locomotives; rail-cars, multiple-unit diesel trains and railway workshops at other railway centres in Holland were also inspected.

Telephone Equipment for Thailand

The G.E.C. Telephone Works in Coventry has recently concluded negotiations with the Telephone Organization of Thailand for the supply and installation of automatic telephone equipment in the capital city of Bangkok to a value of £300,000.

Calendar

The 1956 calendar of Brook Motors, Ltd., has large sheets, each of which has an impression (in colour) by Kerry Lee of Huddersfield, where the company has its works, and of towns in which it has branches. Each sheet shows two months.

Trade Announcements

The Teddington Group of Companies has opened a new branch office and trade counter at 255, St. Vincent Street, Glasgow (telephone: Glasgow Central 3933, Telex 77-155). The Teddington group includes the British Thermostat Co., Ltd., Teddington Industrial Equipment, Ltd., Teddington Refrigeration Controls, Ltd., Teddington Aircraft Controls, Ltd., P. W. Baker & Sons (Sales), Ltd., and P. W. Baker & Sons, Ltd.

In a report of the annual meeting of the **British Thermostat Co., Ltd.**, in our 8th July issue we said that tentative proposals had been discussed for setting up a company to exploit the range of "Teddington" products in New Zealand. We are now informed that this should have read "Australia and New Zealand."

Cathode-Ray Tube Research

NEW FACILITIES AT G.E.C. WEMBLEY LABORATORIES

THE successful production of television cathode-ray tubes on a large scale calls for continuous research and some of the most intriguing problems in this field are provided by the production of the fluorescent screen. For this reason, enlarged facilities, which incorporate a number of interesting new features, have recently been built at the Wembley Research Laboratories of the General Electric Co., Ltd.

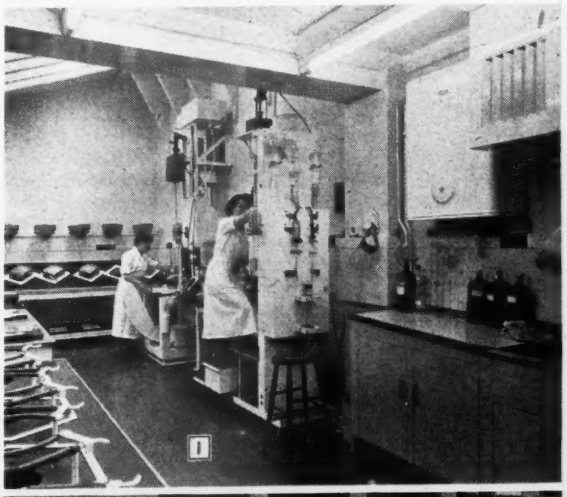
There are several reasons for increased research activity along these lines at the present time. There are, of course, the aims of the manufacturer to reduce the cost of the screening processes, to use better materials in those processes and to provide cheaper cathode-ray tubes. Then, also, the standards of screen quality required have risen considerably during the last few years. The viewer has become accustomed to larger screens that are completely free from defects. Such characteristics as brightness and picture quality are also continually being improved. As screen sizes increase these requirements become more difficult to meet and clearly any increase in screen area also increases the chances of obtaining a screen defect. Further, not all screening processes used for making existing tubes can be used for the larger sizes without modification as some of the properties, such as the viscosity and surface tension of the materials used, are critical, so that the process may have to be re-examined before it can be applied to the manufacture of larger tubes.

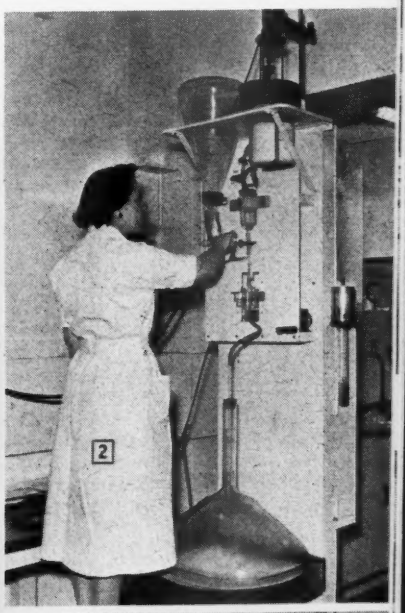
During the manufacture of a screen, it is vitally important that no unwanted impurities enter the cathode-ray tube bulb or the materials used for screening. As little as 1 part per million of copper, for example, can adversely affect the fluorescent properties of some powders, while even one minute particle of dust would cause a screen defect.

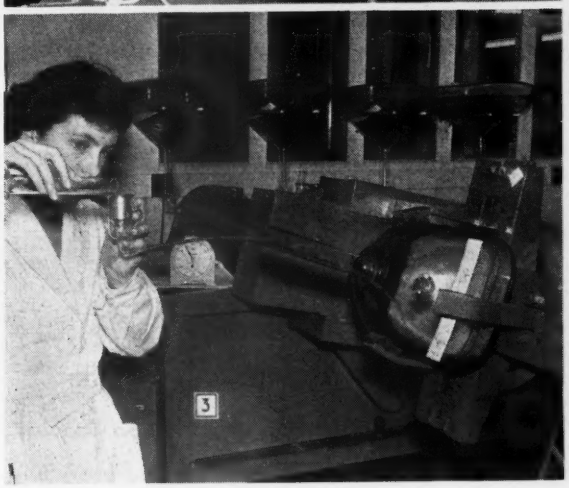
One of the primary considerations in designing the new screening rooms has, therefore, been the provision of a clean atmosphere. Filtered hot and cold air are brought in through two ducts and mixed to give an atmosphere of the required temperature. This degree of temperature control will enable experiments to be carried out on the effect of temperature on the various screening processes used. Later work may also include the analysis of samples taken from the atmosphere, so that the effect of atmospheric conditions in general (including temperature, humidity and pollution) can be gauged.

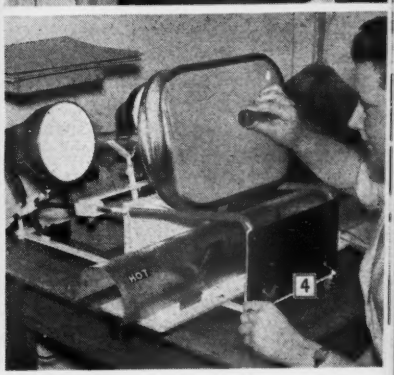
Although atmospheric conditions are easily controlled in the laboratory, some of the equipment used there may be open to the atmosphere. In the factory, on the other hand, the corresponding automatic equipment used for mass production would be completely sealed and thus more independent of atmospheric conditions. The overall conditions of cleanliness in the laboratory will therefore approximate closely to those easily achieved in the factory itself.

The development of a new manufacturing process can









1. One of the special air-conditioned rooms forming part of the new laboratories. Bulb-washing facilities and a screening apparatus can be seen. 2. Experimental apparatus for dispensing controlled quantities of the cushioning liquid and the phosphor suspension for screening cathode-ray tubes. A 24in tube is being processed. 3. Applying the organic lacquer to the screen on a special automatic prototype machine for the flow filming process. When ultimately used in the factory, this process will be fully mechanized. 4. Examining a filmed screen for defects before aluminizing. Special light sources and illuminating arrangements are used

be broadly divided into two parts, the technique itself and the materials to be used in it. A fluorescent screen is prepared in two stages, known respectively as screening and filming. In the former, the fluorescent powder is allowed to settle on to the inside of the glass bulb through a cushioning liquid. All excess liquid is then allowed to drain off by decanting. Since the phosphor screen at this stage has a granular structure, it is necessary to bridge the gaps by covering the powder itself with a thin skin or foil before the reflecting aluminium coating is applied by evaporation. In this process, known as filming, a thin film of an organic liquid is made to cover the phosphor in one of several ways. For example, the irregularities in the screen structure of the phosphor can be filled with water, which is then frozen. A solution of the film-forming material in a volatile solvent is made to flow over it and the solvent removed by evaporation. After the film has solidified the temperature is raised, the ice melted and the water dried out of the screen by evaporation.

Alternatively, in the flow filming method, after filling in the structure of the phosphor screen with water, a solution of the film-forming substance may be allowed to flow over it. The film is then dried out as before.

In yet another method, the flotation process, the film is formed on the surface of a water pool covering the screen. This is achieved by dropping a small quantity of a solution of the film-forming material, in a volatile water-insoluble solvent, on the surface of the water and allowing it to spread. When the film has set, the water is syphoned off or decanted away and the film thereby deposited on the screen. Any residual water held in the screen can then be removed by evaporation through the film.

Experimental work on both the flow filming and the flotation filming processes is in progress at the present time. In both cases, the delicate nature of the operations involved means that the maximum possible degree of mechanization is required to give the optimum yield of perfectly screened tubes. One example of this trend towards automatic operation has been the development of an automatic pipette for use in the flotation filming process. This equipment delivers an accurately measured quantity of the lacquer which will then spread to form the film.

Fig. 1. — Telescoped specimen of the Danish-Norwegian 1955 telephone cable

Danish-Norwegian Telephone Cable

ON 8th November the laying was successfully completed by c.s. *Ocean Layer* of a new submarine telephone cable between Hantsholm (Denmark) and Kristiansand (Norway) for the Danish and Norwegian Post and Telegraph Administrations. It is a coaxial cable of 0·935in diameter over the " Telcothene " dielectric, and with two repeaters of the submerged type it will provide 60 simultaneous two-way telephone circuits over a distance of about 70 nautical miles. The cable is of similar construction to the Netherlands-Denmark cables laid in 1950, and the Aberdeen-Bergen cable laid in 1954; all these cables were manufactured at Greenwich by Submarine Cables, Ltd.

A telescoped view of the cable is shown in Fig. 1 and its attenuation-frequency characteristic in Fig. 2. The inner copper conductor is a composite structure, comprising a strand of seven wires each of 0·0765in diameter, around which is longitudinally folded a tape 0·775in by 0·015in, the interstices being filled with compound. This construction combines excellent flexibility, and the low d.c. resistance desirable for power-feed to the repeaters, with the transmission efficiency necessary at high carrier frequencies. Polythene of Grade 2, mixed with 5 per cent polyisobutylene and a small amount of antioxidant to guard against slight deterioration of properties during processing, was extruded on to the conductor in a single operation to a diameter of 0·935in.

The outer copper conductor consists of a layer of six tapes 0·475in by 0·015in applied with a long lay and bound by an overlapping short-lay tape 0·004in thick. Corrosion protection is afforded by a " Telconax " tape, impregnated with a rubber-bitumen-wax compound. A serving of two layers of tarred jute yarn was followed by alternative main types of armour, 15 No. 1 or 18 No. 4 gauge galvanized steel wires, according to the depth of laying, and the cable completed by two layers of tarred jute yarn applied with bituminous compound. In order to afford means of minimizing extraneous electrical interference, the outer conductor for about 0·5 n.m. at one end and 2·5 n.m. at the other was insulated with Telcothene and covered with lead, with appropriate armour. The complete cable includes steel tape armoured land sections of approximately 1·72 n.m. between the Danish landing and Hantsholm, and 1·67 n.m. between the Norwegian landing and Kristiansand. To assist reduction of noise level, the land cable and the shore ends of the submarine cable are sheathed with lead over the outer copper conductor, which for these sections is insulated with a Telcothene sheath.

The submerged repeaters and terminal equipment were supplied by Standard Telephones & Cables, Ltd. One repeater is laid in 50 fathoms in the middle of the Skagerrack, and the other is installed in a tank of water in the basement of the terminal building at Hantsholm. Carrier frequency bands 24 to 264 kc/s in the southwards direction, and 312 to 552 kc/s in the northwards direction, will accommodate the 60 speech channels. Direct current power feed for the repeaters will be carried by the inner conductor of the coaxial.

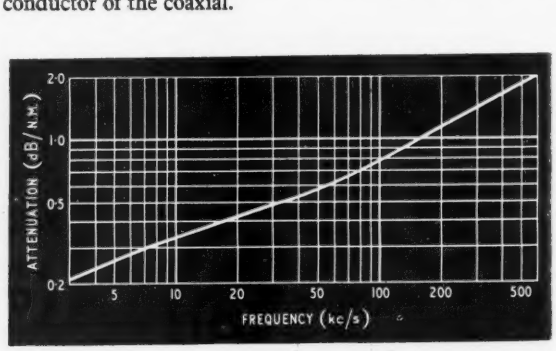


Fig. 2.—Attenuation graph of the Danish-Norwegian telephone cable

PARLIAMENTARY REPORT

WHEN moving the second reading of the Finance Bill, Mr. Henry Brooke, Financial Secretary to the Treasury, said the House would have noticed the respect which Britain had already won abroad in the last fortnight, signalized by the £ having gone above parity with the dollar.

The Government thought that part of the measures to save everyone from the perils of inflation and soaring prices should be shared by every home. It was fantastic to represent purchase tax as a tax on the poor which the rich escaped. The extra cost would average 4d a week for the ordinary household but of course it would come out a great deal more for those people who wanted to buy expensive electric toasters or costly dinner services, both of which up to now, had been bearing no tax at all. Furthermore, many of these goods that had been exempt were made of metal and metal must be used sparingly if the factories which needed it for making exports were not to go short. Remarking that the Chancellor would not be raising the three main rates if he were thinking of lowering them again quickly, Mr. Brooke said that he would not advise anyone to pin hopes on their early reduction.

Mr. John Peyton suggested that the credit squeeze was having a most injurious effect upon the small manufacturers who were wishing, willing and anxious to export. How could they finance an export programme at this time, with a credit squeeze of increasing severity operating? He was not satisfied that the Treasury case against hire-purchase had been made out.

Mr. Grimond found it difficult to believe that by increasing purchase tax the Government would do much to stop inflation. The root cause of inflation was a continual tendency for too much credit and money to get into the economic system. There should be an inquiry into the whole set-up of credit and currency.

Lady Tweedsmuir hoped that the Government, when considering the business of export firms, would exercise the credit squeeze with the greatest restraint.

Mr. Cyril Osborne criticized the "escalator" clauses in contracts, saying that while it was not reasonable to expect the great engineering firms to give a firm price for deliveries two or three years hence, the Government should insist on a firm price for delivery within twelve months. The Ministry of Supply and the Admiralty should be instructed to see how far they could squeeze the waste both in capital materials and labour out of Government contracts. If his suggestion were adopted it would help those in the engineering industry who were engaged on exports and who had no Government contracts. It would do so because the firms with these almost cost-plus contracts could afford to pay higher wages than were agreed by the trade unions and they could steal good labour from firms engaged in export.

Mr. H. Hynd said that the washing machine industry had had several blows in the last few months. One was the hire-purchase restrictions; another was the increase in purchase tax; and the third was the credit squeeze. The Washing Machine Makers' Association had approached the Treasury about an anomaly which he hoped the Government would put right during the committee stage of the Bill. If a trader sold a whole washing machine, including a wringer, it was subject to the full purchase tax, but if he sold a boiler it was tax-free, and the purchaser could put inside an agitator, which bore tax. He hoped that the Government would not drive the industry to try to get round the position by selling a wringer and stand separately.

Sir Edward Boyle, replying for the Government, said that it was necessary to slow down the tempo of investment and to encourage the postponement of marginal investment projects, but it would be contrary to the Government's expansionist policy if they made investment bear the whole brunt of the corrective action now needed. It seemed to follow inevitably that the Government had to reduce consumption. That was the reason for the increase in purchase tax and of the tax on distributed profits. A large number of goods which were subject to purchase tax—such as cars, television sets, refrigerators and other things—competed for the same resources as those which were needed by investment goods and by exports. Certainly, it would be a great mistake for anyone to underrate the burden on the metal-using industries.

The Bill was read for a second time by 320 votes to 255.

Scottish Boards' Expenditure

Mr. Nabarro asked the Secretary of State for Scotland what sum of money per annum was represented by the 33⅓ per cent reduction in promotional advertising expenditure by the South of Scotland and North of Scotland Hydro-Electricity Boards.

Mr. J. Stuart said the expenditure by the South of Scotland Electricity Board and the North of Scotland Hydro-Electric Board on promotional advertising would be reduced by £11,000 and £3,900 per annum, respectively. The expenditure remaining would be £23,000 in the south and £4,100 in the north.

Electricity in the Hebrides

Replying to Mr. M. K. Macmillan, Mr. Stuart said the North of Scotland Board informed him that work in progress would result in the connection of 90 per cent of the potential consumers in Harris and 86 per cent in Benbecula, South Uist and Eriskay. The Board was considering tenders for distribution schemes in Barra (including Vatersay) and North Uist (including Crimsay and Berneray) but had reached no decision.

Thermal and Hydro-Electric Power

Questioned by Mr. Nabarro on coal-fired stations being required to support hydro-electric establishments, Mr. Stuart said that in the exceptional circumstances of the present year approximately 33 million kWh was supplied to the North of Scotland Hydro-Electric Board by the South of Scotland Board in the first ten months of this year, representing approximately 19,000 tons of coal. The completion of further hydro-electric schemes should reduce any future demands made on coal stations.

Temporary Borrowing

Mr. Grimond asked the Chancellor of the Exchequer what reductions had taken place over the last three months in the indebtedness of the nationalized industries to the banks.

Mr. R. A. Butler replied that the maximum amount approved by the Government for temporary borrowing by the nationalized industries to be outstanding on 31st December, 1955, was £58 million, compared with £298 million at 30th September last.

Telephone Development

Mr. Paul Williams asked the Postmaster-General whether he would consider the possibility of instructing the various telephone area managers to put out to sub-contract work which their area staff were incapable of completing in a reasonable time.

Dr. Hill replied that the Post Office staff were now capable of carrying out all the work which the available money and stores would allow.

Mr. Williams asked why it was impracticable for a private householder, for example, to have the telephone moved from one room to another by a private contractor?

Dr. Hill said the Post Office had a magnificent engineering staff to do this job. While they were able to do it he thought no other consideration should apply.

Mr. Gresham Cooke asked the Postmaster-General how the sum of £163 million, which he estimated would be required for development of the telephone service for the two years 1956 and 1957, compared with the present annual expenditure for the same purpose.

Dr. Hill stated that the amount

required for the development of the telephone service from borrowed capital for the 1955-56 programme was estimated at about £69 million. The sum of £163 million might last a little longer than two years, but much depended on prices.

Mr. Ness Edwards asked how much capital had been passed to the Independent Television Authority to date and how far any new limitations had been placed upon its development programme.

Dr. Hill said that the amount was £305,000 at rates of interest varying from 3¼ to 5 per cent. The need for restraint in capital expenditure has been stressed with the I.T.A. as with other public authorities, and the Authority's proposals in this field would be carefully scrutinized.

Post Office Finance

When Dr. Hill moved the second reading of the Post Office and Telegraph (Money) Bill in the Commons, he said it provided for the issue of £175 million for new developments in the Post Office services. This would include £42 million for trunk lines, £27 million for local lines, £31 million for subscribers' circuits, £36 million for exchange equipment, £3 million for the transatlantic cable, £4 million for other telephone developments, and £5 million for postal and telegraph services. That was a total of £148 million for new plant, the remaining £27 million being made up of expenditure on sites and buildings.

Within the next four years further automatic trunk exchanges would be brought into operation in Birmingham, Bristol, Carlisle, Chester, Leicester, Manchester, Middlesbrough, Nottingham, Portsmouth and Swansea. "On the horizon" was the mechanization of the trunk services to enable the subscriber to dial his trunk calls anywhere.

In 1935 a 100-mile trunk circuit, say from London to Birmingham, cost more than £8,000; to-day, as the result of research, it could be provided for less than £1,000. A private electronic exchange was actually in use at the research station at Dollis Hill, and the prospects were promising.

Capt. L. P. S. Orr referred to the development of carrier telephony, a device whereby up to 600 conversations could take place along the same line. Information reaching him from the United States tended to show an extraordinary disparity in the cost of providing such capital equipment as between the U.S.A. and this country. For the channelling gear which was necessary for the provision of this service in this country he had been given the figure of about £2,000 to make one channel effective. The Bell Telephone Company in the United States was providing similar equipment at about £200 a channel.

There appeared to be a grave lack of healthy competition in the provision of equipment for the Post Office. In fact, the provision of carrier equipment was in the hands of no more than two companies. It was in a tight ring which was dominated by Standard Telephones & Cables. Its position was quite astonishing. Not only was it owned by a parent company in the United States, but it had permission from the Treasury to export all its profits in dollars to the United States.

Mr. W. R. Williams said he could not follow the argument about the activities of S.T. & C. but he did know that for a long time the association between it and the Post Office had been very close and that whatever benefits had accrued to the company had benefited the Post Office because the company had given the best standards of work on all occasions.

Mr. C. R. Hobson said that Britain was behind other countries in the development of electronic exchanges —he mentioned South Africa and the U.S.A. in particular.

Replying to the debate, Mr. Gammans, Assistant Postmaster-General, said that he would look into the allegations made by Capt. Orr about Standard Telephones & Cables. He would give the results of his investigations later if Capt. Orr would put down a question on the subject. Concerning contracts generally, the Post Office had bulk agreements for certain types of equipment. In 1950 the agreements were examined by a Select Committee and they were given a completely clean bill. In 1952, however, the Monopolies Commission looked at the cable contracts and suggested that a proportion of them should be made available to firms who were not covered by the bulk agreement. The Post Office had done that, having set aside an empirical amount of 10 per cent for which outside firms could tender. One of the curious things discovered was that in many directions they could not get outside firms to tender, but it was a useful safeguard.

The difficulty about the new development of electronic exchanges was to know when the experimental development had reached a stage when it could be put into mass production. The Post Office treated this as a matter of the greatest concern. The last thing they wanted to do was to put in equipment which in a few years would be out of date. The export trade in telephones remained steady and was now running at the rate of about £15 million a year.

Tenders for American Contract

Mr. Fernyhough asked the President of the Board of Trade what reply was received from the State Department to the written representations made by Sir Robert Scott, the British Minister in Washington, about the tenders for the Chief Joseph Dam; Mr. Bottomley asked if he had any further statement to make about the rejection by the United States Government of a lowest tender for an electrical undertaking submitted by a United Kingdom firm.

Mr. Peter Thorneycroft said the State Department defended the action taken on the ground that the contract was to be carried out in the United States in an area of substantial unemployment. The reply also stated that the decision did not represent a departure from the principles laid down in the President's Executive Order of December, 1954, or from the declared objectives of the United States Government to pursue a liberal foreign trade policy. No useful purpose would be served by replying further to the United States' note.

Enfield Line Electrification

The Minister of Transport (Mr. Boyd-Carpenter) informed Mr. Ernest Davies that the British Transport Commission's scheme for the electrification of the Liverpool Street to Enfield Town railway had been approved in principle and detailed planning was well advanced. It was still too early to say when the work was likely to begin.

Harmful Radiation

Mr. Mason asked the Minister of Works to what extent at Harwell, Sellafield, and other active atomic power stations the full permitted dose of radiation was still regarded as safe, and if he would make a full statement indicating the dangers inherent in this type of work.

Mr. Birch stated that the United Kingdom Atomic Energy Authority, in deciding the maximum permissible level of radiation for the staff, followed the recommendations of the International Commission on Radiological Protection, which were designed to ensure that workers exposed to radiation would not suffer in health. The precautions taken at Harwell and Sellafield in fact reduced the average radiation exposure of employees at those establishments to considerably less than one-tenth of the maximum permissible level.

Private Members' Bills

The Private Members' Bills introduced on 9th November included the following (dates of the second reading debates given in brackets): The Rural Transport Improvement Bill, introduced by Mr. Baldwin, to make provision for the improvement of transport in rural areas by rail, road and water (9th December); the Industrial Rating Bill, introduced by Mr. Sparks, to repeal legislation dealing with industrial de-rating (16th March); and the Automation and Electronics Bill, introduced by Mr. R. Edwards, to provide for the establishment of a permanent committee to inquire into, review, and report on the social, educational, cultural and economic needs and consequences of the application of automation and electronic devices to British industry and agriculture (9th December).

German Scientific Recovery

A REVIEW OF THE PAST TEN YEARS' WORK

WESTERN Germany entered the post-war period with its scientific and technical resources in ruins. Research work was at a standstill, many research establishments were completely destroyed and scientists were scattered. In a 103-page review just published at 4s for the Department of Scientific and Industrial Research by H.M. Stationery Office there is a most interesting description of the remarkable recovery which has taken place during the past ten years. The report outlines the steps taken to rebuild laboratories, encourage the activities of learned societies and bring scientific records and literature up to date. The review was prepared by the United Kingdom Scientific Research Organization, which was formerly part of the Control Commission.

The almost complete collapse of scientific and technological activity in Western Germany made it possible to rebuild the structure of its scientific and technical organization on modern lines, so that to-day the country has gained a position among the world's leaders in technology, although it still lags behind in those fields in which applied research was restricted or forbidden by post-war controls: aerodynamics, radar and nuclear science.

Extensive Industrial Research

Industry has played a great part in the rebirth of science in Western Germany. It is estimated that the major chemical industries devote at least 5 per cent of their turnover to research, the corresponding figure for engineering concerns being 1 per cent. Industrial firms are setting up their own research and development laboratories, one electrical firm having recently completed a research centre accommodating 1,200 workers. Another undertaking built four large research laboratories in eighteen months. Industrial laboratories of this sort concern themselves not only with the day-to-day technical problems of industry but also with programmes of fundamental research comparable with those carried out in more academic research centres. German industrialists keep in close personal touch with academic scientists and often employ them as advisers on technical problems.

Western Germany is now entitled to build and operate a nuclear reactor which will be used for the purpose of instruction in nuclear technology, for the production of radioactive isotopes and to provide experience to be used in the construction of future reactors. A synchro-cyclotron is to be built at Bonn University to further the study of radiation and nuclear physics and Western Germany is represented on the European Organization for Nuclear Research, which is to construct a large nuclear machine at Geneva. The acceleration system for the proposed machine is being designed at Heidelberg.

The electrical and electronic industries are active in development work and there has been notable progress in power generators, in the heavy equipment field and in electrical instruments of all kinds. In the electronics field there has been active development of computers, while the radio industry has paid increasing attention to frequency modulation.

Germanium diodes and transistors are attracting attention. Most of the larger firms are doing some research and development work on this subject, but both Siemens and Telefunken are reported to be negotiating for licences from Bell Telephone Laboratories in the United States to manufacture components. Germany is not yet abreast of competitors in this work, or in travelling wave tube excessive sensitivity to overload has caused work on bound-development. Lack of demand due to unreliable and contact transistors to be practically given up. Research on junction transistors has been continued, notably in the research establishment of the Federal Post Office at Darmstadt.

So far only germanium transistors have appeared on the market, but experiments with silicon, silicon-germanium alloys and intermetallic compounds are being continued. Experimental transmitters and receivers incorporating transistors have been built, one transmitter being intended for use with a lapel microphone for lecturing. In one case, a superhet receiver contained ten transistors. The Philco research laboratory has developed a silicon transistor, suitable for frequencies up to ten Mc/s, which is extremely compact and heat-resistant up to 300 deg C.

In the electrical engineering industry several firms are studying gas turbine generating plant. The Siemens-Schuckertwerke still dominates the development of heavy electrical equipment and recently delivered to West German stations two 150 MVA turbo-alternators with hydrogen cooling. The length of the machine has been reduced by using hollow conductors and a hydrogen pressure of 30 lb/sq in. A set of 190 MVA is at present under construction, also for Western Germany.

The Siemens-Schuckertwerke and the Studiensgesellschaft für Höchstspannungsanlagen at Ruik near Esslingen have both developed a.c. grid models for the study of power supply networks. In the Mannheim area a study group, supported by grants from industry and Government, is developing 400 kV a.c. overhead power lines. Research bodies abroad have shown interest in this project.

The A.E.G. has produced a generator combining the features of compound excitation, automatic voltage regulation and self-excitation. The same company has developed mercury-jet turbo-rectifiers and invertors for a variety of purposes. Turbo-rectifiers have been supplied for starting aircraft at various European airports and it is hoped to apply this type of rectifier to electrolytic baths. The turbo-invertor was developed at the instigation of the German Federal Railways, which use them for fluorescent lighting in trains.

Television in Trains

The company is at present working on the development of mercury-jet turbo-type automatic installations for voltage and frequency regulation for the provision of a.c. to transportable high-frequency installations. Here again the initiative has come from the Federal Railways, who wish to equip their touring trains with television. Other intended uses are for air conditioning and for emergency equipment in telephone exchanges.

In November, 1953, A.E.G. opened a high voltage institute at Kassel, which cost DM. 6 million. It serves the company's e.h.v. switchgear factory nearby, but is available for testing and research on behalf of A.E.G.'s other units. There are two sections, for h.v. and heavy-duty work, respectively. The institute has a "weather room," big enough to test the largest existing switch over a

temperature range of −40 deg C to +80 deg C at any humidity and in rain. Its main fields of investigation are overvoltage phenomena in e.h.v. switches; protection, supervision and stability of the grid; h.v. electric arcs; glow input voltage; and building-up frequency in h.v. networks. In view of the increasingly high voltages envisaged for overhead power transmission lines, research and investigations have been under way in Western Germany on the problems involved in the establishment of a 400 kV European long distance circuit.

Electric Arc Plasma

The research laboratory of Siemens-Schuckertwerke at Erlangen has made theoretical and experimental studies of electric arc plasma, which should be of interest in switching technique. Theory led to the establishment of equations describing what has been called "plasma dynamics," which represents a synthesis of gas dynamics and electro-dynamics. In practice, a plasma stream is ejected from a chamber with an electric arc in a high-pressure water vapour atmosphere. When the plasma stream is ejected at a speed greater than Mach 1, oscillations take place—due to the different masses of the ions and electrons—and the stream breaks up into sections, as in the well-known case of rocket exhaust gas streams. This work has a parallel in that which has been going on for some years in the institute of experimental physics at Kiel University, where an underwater arc, giving a claimed temperature of 50,000 deg C, has been developed.

The electrostatic generator has in recent years been raised from the status almost of a toy to become an important part of modern physical laboratory equipment. A modified generator, recently developed at the University of Tübingen, has two discs of insulating material rotating in opposite directions with only a very small gas layer between them. In the experimental apparatus they are of 11 cm diameter and 1·8 mm thickness. Briefly, the performance is as follows:—At 6,000 r.p.m. and a separation of 0·3-0·5 mm a current of 0·3 mA at 28 kV can be obtained when the pressure is 5 atmospheres. When it is 20 atmospheres the values are 1·0 mA and 75 kV. The output per unit volume, 0·12 W per c.c., is as high as that of the ordinary type of electromagnetic generator. The efficiency of this electrostatic generator is 90 per cent, comparable with that of the electromagnetic type.

The A.E.G. has studied the problem of a.c. motors working at 60,000 r.p.m., particularly with regard to control of centrifugal forces, bearings, clutch, and shaft vibration. The practical development of such motors has begun. The A.E.G. valve factory in Berlin has developed a stamping process for the manufacture of large-area photo-resistances and also an X-ray tube with a square focal spot on the anode, using a coil instead of a spiral as cathode. This has the advantages that the anti-cathode can be more heavily charged and that sharper pictures are obtained. The same factory has produced an X-ray tube with electrostatic lenses giving an adjustable fine focus, which is useful for investigations into fine structure.

Work on computer development is in progress at Göttingen, Darmstadt and Munich. Each team is working on independent lines but all are assisted financially by the Deutsche Forschungsgemeinschaft which has set up a special commission for computing machines.

The Göttingen electronic computer (G_1) was in continuous operation from October, 1952, until March, 1953. A second computer (G_2) is now in operation, while plans for a third (G_3) are under way. The G_1 computer is a serial binary computer, relatively small and easily built, with programmes on punched tapes; it has 476 valves and 101 relays. The G_2 computer is a serial computer controlled and synchronized by a multi-drum store of 30 cm diameter, with 64 tracks and 32 numbers on each operating at 3,000 r.p.m. Final plans for G_3 are not yet available but it will probably be a parallel computer with a high-speed store consisting of a matrix with a ferrite core.

The binary parallel Munich computer has almost reached the production stage. Its main feature will be a high-speed magnetic-drum storage with 8,192 decimal numbers of 50 digits each. The diameter of the drum is 10 cm, its length 20 cm and it operates at 1,500 r.p.m. with an average time of 2 millisec.

The Darmstadt computer is a decimal serial computer with a photo-electric selector for the drum store. It has an intermediate store of magnetic cores with rectangular magnetizing loops. A rectifying circuit is used in the arithmetical units and also a photo-electric tape reader. A network of selenium rectifiers or germanium diodes is incorporated with magnetic drum storage of 3,000 numbers of effectively 13 decimals. This computer is in operation and is said to have been used for the evaluation of equilibrium constants in certain chemical reactions. A Swiss computer of K. Zuse manufacture, specially designed for calculations in the field of optics, has been installed at the works of E. Leitz, of Wetzlar.

Accumulator Developments

The Deutsche Edison Akkumulatoren G.m.b.H. has brought out two new types of accumulator, the gas-tight nickel-cadmium miniature form for low-voltage purposes and the "Durac-Akkumulator," with sintered plates, for shock duty. The first-named is for use in portable apparatus and the smallest is a flat cylinder having the diameter of a farthing, with weight 5 gm, volume 1·17 cm^3 and capacity 60 mAh at 6 mA discharge rate. Others range through a disc form about the diameter of a penny, 90 mAh capacity, to a steel cylinder ½in by 2in with capacity 450 mAh. The button type can be used as an anode battery, as can the steel type. Portable radio receivers and hearing aids have been equipped with gas-tight steel accumulators, the receivers using them as heating elements and being charged by the built-in power circuit. For the hearing aids special small chargers for use with 110/220 V a.c. are made, ten hours at the most being required. The advantages claimed are that the 12 Wh per kg of the normal accumulator has been nearly doubled and that, whereas the normal cell of 800 mAh occupies 49 cm^3, the new gas-tight cylinder giving 450 mAh occupies only 8 cm. The "Durac-Akkumulator" with sintered plates is used where peak load makes greater demands than capacity. It is said to be 35 to 40 per cent smaller and lighter than those which it supersedes. It can be charged at a high rate, an hour being then sufficient.

The firm of Osram is actively developing xenon high-pressure lamps. The particulars of the latest and most powerful type are not yet available but the following account of type XBO 1001 may be of interest. It is in the form of a glass tube 275 mm long with a bulb 40 mm in diameter blown in the middle of it. Here the two solid tungsten electrodes approach each other to within a few mm, the positive being three times as large as the negative and both presenting cones as operating surfaces. The pressure of xenon gas is a few atmospheres and 45 A d.c. is used. The working voltage of the lamp is 22 V but with a resistance in series 65 V is applied. The power dissipated in the lamp is 1,000 W, 32,000 lumens is the light emission and 40,000 stilb the intrinsic brightness (cf. 150,000 stilb for the mid-day sun). Air-cooled xenon lamps of 2 kW and water-cooled types up to 6 kW are now being produced by the firm, the higher powered lamps being a.c. operated.

LETTERS TO THE EDITOR

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for the opinions expressed by correspondents.

I.E.E. Regulations

BEFORE the publication of the 13th edition of the I.E.E. Wiring Regulations a number of "earth loop resistance" test sets were available on the market. These sets were designed to enable and encourage speedy and accurate testing of the earth-neutral circuit, bearing in mind simplicity of operation and ease of carrying. The electrical design was based on the realization that "several amperes" were required in the test circuit, rather than a few milliamperes, to obtain reliable information of the fault current. Experience has shown that these sets are giving satisfactory service.

Now we have the much discussed 13th edition requiring "earth-neutral impedance" tests to be taken on all sub-circuits in which "it is preferable for the current used in the test to approach 1½ times the rating of the sub-circuit, but in no instance need it exceed 25 A." This last statement has created a widespread impression that every test set must deliver 25 A through a 1 ohm load, otherwise the test is not being carried out according to the I.E.E. Regulations. This is surely reading more into the Regulations than is intended.

On looking at the report which is probably responsible for the new Regulations, viz. E.R.A. report V/T111, it is apparent that impedance tests on mild steel conduit shows a maximum value when the test current is between 20 and 30 A. However, at 10 A the impedance drops by only 15 to 20 per cent, depending on fault conditions, and since this forms only a part of the total loop impedance it is evident that the resultant difference between 10 and 25 A tests will be small enough to be neglected. If there are installations where it is known that steel conduit is used extensively allowance can readily be made for this factor in assessing the loop impedance.

The point of this argument is that the electrician who has to carry out the test requires a handy and economical piece of equipment which also incorporates a measure of self-protection when in use. This can be achieved if the output of the set is limited to approximately 10 A, the weight being 7 lb. A 25 A set, however, would weigh in the region of 20 lb. It would be helpful, therefore, if some measure of agreement could be reached between engineers involved in the design and use of earth impedance test sets on the validity of tests at the limited output.

We have gone a long way to increase safety by firstly introducing the resistance test at "several amperes" and, secondly, changing to the impedance test, but I believe 10 A is far enough while still keeping within the requirements of the 13th edition of the Regulations.

Wimbledon, S.W.19. R. E. JENNINGS, A.M.I.E.E.

London's Electricity Supply

IN his excellent article (*Electrical Review*, 4th November) Mr. R. Thompstone does less than justice to the far-sighted pioneers who placed their faith in a.c. from the outset. He says that from the early 1880's supplies were "usually given on some variety of d.c. system."

In truth, the Coutts Lindsay Co. (later the London Electric Supply Corporation), the Brompton & Kensington Co., and the Westinghouse Co., all adopted a.c. from their inception. Writing of conditions in the 1880's Dr. H. H. Ballin, in his book "The Organization of Electric Supply in Great Britain," says:—"The increasing popularity of the a.c. system amongst engineers led to the replacement of d.c. plant even for lighting."

The change-over to a.c. was again in evidence on a very large scale about 1910 after the advent of the metal-filament lamp, to such an extent that the d.c. companies were forced to make arrangements with the a.c. companies to slow down the change-over which, unchecked, would have put the d.c. companies out of business.

The change-over to a.c. which Mr. Thompstone quotes as having begun in the early 1930's was only a recrudescence of a phenomenon which had appeared previously and which had reached "landslide" proportions some twenty years earlier.

Bromley, Kent. E. H. JESTY.

Kettles and Jugs

I WAS rather interested in the comments in a paragraph in "Views on the News" in the *Electrical Review* of 29th July last. I judge from "Reflector's" remarks that an electric jug is an appliance with which he is not very familiar and as far as my knowledge of British-manufactured small domestic electrical appliances goes, I am not surprised because I cannot recollect having seen any British literature dealing with such appliances.

On the other hand, an electric kettle whilst not unknown to us is more an oddity in this country than anything else. Although at times there has been an opportunity for New Zealand importers to import British-made electric kettles I do not know of many having been imported, probably fundamentally because the wattage is too low and consequently the boiling time too long.

Most of the kettles manufactured overseas have an element clamped to the underside of the kettle bottom and whilst theoretically it is possible to boil a small quantity of water such as one might require for one or two cups of tea, in general there is a fair wastage of water heated or boiled in electric kettles and the replacement of a burnt-out element is not the easiest job. Strict compliance with the regulations in this country would require that such an element be replaced only by a registered electrician.

However, in New Zealand for some years now we have used coiled elements which are manufactured by quite a number of firms in this country. Under separate cover I am forwarding a catalogue which may be of passing interest to you. From this you will see that we use elements of 1,500 watts capacity. It is, of course, essential that these be covered by water but obviously a lesser quantity of water can be boiled in a jug than in a kettle and therefore the wastage is less.

The element is inserted from the inside through a hole in the side of the jug and is secured by means of a rubber washer and ferrule. Electrical connections are made with the usual appliance plug. You will appreciate, therefore, that if a consumer does allow the jug to boil dry or if the element otherwise burns out it is a very simple replacement job. Blades on the outside end of the element boss are the earth connections. Incidentally, one or more of

the local manufacturers of these elements is exporting fair quantities of them to Australia, I believe.

Whilst you may think the use of an electric jug strange, on the other hand the continued use of a kettle seems a little strange to me and I think you might be interested in this exchange of ideas.

I am not in any way connected with the producers of this catalogue. It merely happens to be one my staff handed to me when I asked for an illustration of an element.

Auckland, New Zealand. O. J. RUFF.

[This letter is commented on in a leaderette on p. 966. —Editors, *Electrical Review*.]

Electric Cookers

I HAVE read with interest the correspondence and comments on electric cookers which have appeared recently in your pages. I have had experience of both gas and electric cookers (more as an observer than an operator), and while possibly the cast electric hotplates may be a little slower in some ways, I feel with the thin walled saucepans and the high-temperature gradients of a gas cooker there is a greater liability to local overheating. Intelligently used, either is capable with equal ease of performing its functions.

There is, however, one point which always seems to be left out of these arguments and that is that gas requires a considerable volume of air for its combustion and the products of combustion have to be discharged somewhere. So far as I know, they are usually discharged into the kitchen and these hot gases carry with them grease vapours from the cooking food and the grease is deposited on the surfaces of the kitchen in the form of a greasy film. This leads to a much more rapid deterioration of these decorated surfaces than it is my experience to find with electric cooking. I would regard this as a very strong point in favour of electric cooking.

Sutton Coldfield. J. A. WALTERS.

IF my letter did nothing else it did at least result in Mr. Jordan getting some first hand knowledge about the new electric cookers. Now all that remains is for him to try one, I can assure him he will not regret the experience.

He can buy a fully automatic electric cooker (well enamelled) for much less than some of the more expensive gas cookers but even if he chooses a model which is rather more expensive he will realize that one generally has to pay more for the best, and in any event he will save money on his energy account. I was sorry to hear about the reflector plate with the raw edge.

Brighton. R. E. GAMLEN.

Transistor Digital Fast Multiplier

OPENING the discussion on the I.E.E. paper entitled "A Transistor Digital Fast Multiplier" which was summarized in the *Electrical Review* of 11th November, Mr. E. H. Cooke-Yarborough (A.E.R.E.) suggested that some of the antipathy to point transistors might be due to laziness. He commended the authors on their use of symbols.

Mr. T. R. Scott (Standard Telecommunication Laboratories) congratulated the authors on combining valves, transistors and magnetic devices in one system, which, in his opinion, would be future practice.

Mr. B. W. Pollard (Ferranti), agreed that one of the main simplifications achieved had been the bringing together of valve type and transistor circuits. Each had been used where it was most suitable.

Dr. Grimsdale (Manchester University) said, on the question of junction *versus* point-contact transistors that, while the junction transistor was more reliable, the point-contact transistor was probably better at the moment in very high speed circuits. Dr. J. H. Stephen (A.E.R.E.) remarked that the reliability of the transistor could be established only by thoroughly checking the programme involving a wide variety of digit patterns.

Mr. J. S. Walker said that difficulty was caused by the absence of actual figures as to the reliability of both point-contact and junction transistors.

Mr. K. W. Cattermole said that unreliability was still the biggest defect in the point-contact transistor, though it had advantages in cost, speed and circuit versatility.

Mr. Thompson noted that no means were provided for checking multiplications and asked whether consideration had been given to working back from the answer to the products. Mr. N. Kitz inquired what speeds and reliabilities could be obtained from point-contact and junction transistors and whether they were really going to take the place of valves in computors.

Mr. S. Kaye asked whether the point-contact junction had a higher switching speed than the junction transistor because the current gain was greater than one or whether there was some other reason.

Mr. C. J. Dakin inquired whether the material had to be nickel, whether it was stressed mechanically and why it had to be stranded. Mr. P. P. Eckersley, referring to speed and reliability, said there were two techniques: to do the calculation three times and see whether the result was the same and to do it once and make it reliable.

Mr. H. Stanesby (chairman) asked how the authors' comment on cost—that the ratio of crystal diodes to transistors was about six—was to be interpreted.

Electron Trajectories

TWO papers were presented by Dr. D. L. Hollway (Commonwealth Scientific and Industrial Research Organization, Sydney, Australia) before the Institution of Electrical Engineers (Measurements Section) on 15th November. The first described a general purpose electrolytic tank (120 by 60 by 30 cm deep) and novel equipment for determining electron trajectories, potential and potential gradient and for marking equipotentials. An analogue path computer using such a tank was shown to have advantages in speed, accuracy and convenience over alternative methods, such as graphical construction and the use of rubber-membrane models. The tracing of electron trajectories in crossed electric and magnetic fields, which became of importance in an increasing number of electronic applications, provided the subject of the second paper—an extension of Gabor's tangent method. The magnetic field could be either constant or variable with position if the distribution were known. The technique could possibly be extended to time-varying fields. By a simple modification of the tracer circuit the acceleration due to the magnetic field was included. Experimental results given included a comparison between a trochoidal path and the calculated and typical paths in a split-anode magnetron

Semi-Conductor Rectifiers

Development of Germanium and Silicon p-n Junction Types

AN integrating paper concerning the developments which have led to present practice in germanium and silicon power rectifiers, in which the rectifying barrier is integral with the body of the semi-conductor, was presented before the Institution of Electrical Engineers on 10th November by Messrs. T. H. Kinman, G. A. Garrick, R. G. Hibberd and A. J. Blundell (British Thomson-Houston Co., Ltd.).

The authors confined their attention almost entirely to the p-n junction rectifier, in which two sections of a crystal lattice included different impurity atoms, having one less (the p-region) and one more (the n-region) valence electron than the semi-conductor atoms. On completion of a circuit through the crystal, free electrons from n crossed the junction and combined with the positive holes, to be replaced by further holes flowing into the p-region under the influence of the applied electric field. Simultaneously holes from p crossed the junction and were mostly filled by electrons before reaching the base contact, since the n-region was now filled with electrons flowing in from the external circuit.

With reversal of polarity of the applied field, electrons in n and positive holes in p progressively moved away from the junction, leaving the two regions with net positive and negative charges, until the potential so produced equalled the applied voltage, when the current almost ceased. The reverse current did not reach zero, however, owing to thermal agitation of the atoms, which increased rapidly with temperature (doubling this current for each 10 deg C rise) and caused a simultaneous generation of electrons and holes. In the absence of an electric field these were diffused through the material until an electron encountered a hole and recombined. Breakdown in the reverse direction might be caused either by increase of this saturation current with temperature or by the voltage gradient becoming sufficiently great to tear electrons out of their orbits in the crystal structure.

There were two types of p-n junction. One was produced by heat treatment of a grown crystal; the second was obtained by fusing one impurity element into one surface and another into the opposite surface of a wafer of a single crystal. The fused type, permitting much higher current densities and being easier to make, was at present preferred for power devices.

Germanium was recoverable from flue dust, but chemical purification to the required standard generally presented economic difficulties. Methods of preparing the semi-conductor materials and of dealing with their inherent properties in the manufacture (including works tests) of low, medium and high-power units were described.

Silicon gave a lower reverse current for a given temperature than did germanium, and its limitations in operation at high ambient temperatures were therefore less. Maximum junction temperatures of around 300 deg C were possible with silicon compared with 75 to 100 deg C with germanium. The production of silicon in the requisite refined state presented greater difficulties, however, although ratings of above 1 kW had already been reported. Silicon would be more extensively used when more economically producible.

Rectifiers of low and medium powers were already well established for applications requiring low-voltage d.c. supplies in which small volume and weight were requisites. Single germanium units rated at over 100 A had been made experimentally. Since December, 1953, the first germanium power rectifier in this country, believed to be the first of 300 kW rating in the world, had run for over 10,000 hours, replacing a grid-controlled glass-bulb mercury-arc rectifier in a British lamp works. It occupied one-sixth of the space and had a 6 per cent higher efficiency, saving £700 per annum in power. A second 300 kW unit was installed in the same factory more than a year ago to supply a 500-250 V three-wire d.c. system. Another equipment for 1,000 kW was put into continuous service last August. One of 18,000 kW now being built was the largest germanium installation on order in any country.

The overall efficiency of a germanium rectifier (including transformer) was 97 per cent and remained high down to 10 per cent of full load. For electroplating, needing heavy currents at 5 to 50 V, there seemed to be no economic alternative. As a germanium rectifier was made up of a number of units in series and parallel the cost/kW was more nearly constant than that of a mercury-arc rectifier which could deliver nearly as much current at 600 V as at 200 V. This implied a voltage, as yet undetermined, at which one or the other would entail lower capital expenditure.

DISCUSSION

Dr. W. G. Thompson (G.E.C.), opening the discussion, referred to the paper as a model of technical literature in its clear handling of a complex area of theory, ideas, processes and imposing results. It also showed how, in attacking the main problems in engineering, particularly electrical engineering development, one had to call upon the resources of most of the physical sciences, the physics of to-day being the electrical engineering of to-morrow, as in the germanium rectifier. The paper also exemplified the principle that the success of a new development depended on its having a margin of advantage over existing types of equipment—usually in greater economy without sacrifice of reliability. While the storage of holes required greater clarification, the germanium rectifier had undoubtedly a great future.

Mr. T. E. Houghton (I.C.I.) said that the germanium rectifier, although having a slightly lower efficiency than other rectifiers, possessed the advantage of having no moving parts; it was very compact and might be cheap. Relative costs at the moment were: motor convertors, £100; mercury-arc rectifiers, £139; contact rectifiers, £79; and germanium rectifiers, £74. If the last named did not deteriorate and had a life of 100,000 hours at least, users would be very satisfied. He had just had a large motor convertor taken off after 87,000 hours without attention to the commutator, so this demand was by no means ridiculous.

Mr. H. West (Metropolitan-Vickers) asked whether the authors had considered the application of germanium rectifiers to traction. He presumed that metallurgical fusion processes made the high-powered rectifier worth while and thought the original drawing of the germanium

crystal and the doping and re-doping of the bath most elegant, though it did not look to be wholly practicable.

Dr. E. Eastwood (Marconi W. T. Co.) said that as a result of the application of germanium to the heavy duty rectifier during the past two years his company had produced a semi-conductor device differing in one or two particulars from that of the authors. The horizontal pull technique had been used for both the preparation of the material and the growing of the final crystals; this produced a profile which was dead level, making the process more economical.

Mr. J. A. Broughall (B.T.C.) thought that the older generation was not familiar with the conception of moving holes and that there should be more definitions of the symbols. The traction engineer, he said, was interested in rectifiers suitable for reverse voltages of 500 to 900. In a few weeks it was hoped to report the successful trial of the first germanium power train.

Major L. H. Peter (Westinghouse Brake & Signal Co.) pointed out that the paper fulfilled a prophecy in June, 1941, by the late Professor C. L. Fortescue that when the theory was fully understood there would be considerable improvement in the efficiency of semi-conductor devices. A British Standards Institution committee had already been set up, and it should be extended to cover germanium and silicon rectifiers also. If agreement could be reached, they would be in a better position to discuss the matter in the I.E.C. where it was already scheduled.

Dr. J. C. Read (B.T.H.) thought that while the engineering application owed its inception to brilliant original American research work, it was further advanced in Britain than anywhere else. One of the most important applications was to heavy-current low-voltage electrolytic processes. The overall efficiency of mechanical rectifiers had about reached its limit but that of germanium rectifiers would very probably be further increased.

Mr. L. J. C. Connell (G.E.C. Research Laboratories) suggested that the main future advance would probably be in the achievement of higher operating temperatures and higher peak inverse voltage ratings.

Mr. A. Langridge questioned whether the clean rectifier was not a worse device than the one covered with the proper impurity or with an impurity which would allow the inhibition effect to occur and keep the reverse current down to low values. He asked whether the authors' rectifier required an impurity layer on the surface to keep the saturation current down to low values and whether the lifetime of the device was dependent upon such a layer.

Mr. Bingley thought the surge rating ought to receive close attention, since most of the suitable applications for these rectifiers at present suitable might form what was in effect a capacity load.

Automation and Management

B.I.M. Harrogate Conference Paper

IN a paper which was delivered at the recent conference of the British Institute of Management at Harrogate Mr. John Diebold, president, John Diebold & Associates, Inc., U.S.A., dealt with automation and its impact on management in the future. He said that the more we talked about automation, the less confidently we could assume a common understanding of the term. The word " automation " had come to mean so many things, to so many people, that, for the moment, it was losing a good deal of its usefulness.

Automation had become an *issue* and as a result was too often discussed with less regard for the facts than for the particular preoccupation of the speaker. We heard automation characterized variously as a potential threat to the national economy, as the key to increased leisure and a five-day week-end, and as a mystical pseudo-science of robots and giant brains.

If it meant anything at all, automation implied a basic change in our attitude towards production and something more than mechanization. All industrial production originated in the concept of the division of labour according to skills. Production processes were divided to allow for the most efficient use of individual human skills and in most cases mechanization did not change this. Machines were introduced into the process structure by and large precisely as that structure had been designed around human skills. Department managers mechanized their departments and because of the high cost of special-purpose machinery, processes became even more widely divided; what had once been departments within a plant became separate activities, often housed in separate plants.

However, the most efficient use of machines had little to do with the most efficient division of human skills. Until recently, this was one of the paradoxes inherent in the nature of mechanization. With the introduction of self-regulating systems, however, it was no longer necessary to design the production process around the limitations of human skills. It was here that we began to reach the heart of the true meaning of automation.

Automation was more than the technology of feedback. It differed from mechanization in the way it regarded the problem of production. Automation required us to view the production processes as an integrated system and not as a series of individual steps divided according to the most economic distribution of human skills—or even of individual machines. It was a means of analysing, organizing and controlling our production processes to achieve optimum use of all our productive resources—mechanical and material as well as human.

The chemical processing industries represented an ideal illustration of a process that had advanced to the second phase of automation. They had completely changed the nature of their process from batch to continuous flow to allow a high level of automatic operation, instrumentation and control. They were now beginning to achieve a higher level of automation: the integration of separate control functions into complete self-regulating systems in which the optimum relationship of variables was maintained by a continuous comparison with the desired qualities of the end-product.

If a concept of automation was simple, the technology which we encountered when we talked of self-regulating systems was incredibly complex. Here we were dealing with what was easily among the half-dozen most advanced frontiers of technology. Fundamentally, it was a science of communication and control. It had resulted in such innovations as the use of automatic control devices to permit the automatic but highly flexible control of individual machines, the design of entire processes as automatic self-regulating systems, and the development of automatic information-processing machines and systems capable of

recording, storing and performing complex mathematical or logical operations upon information provided them.

The application of this technology throughout industry had only just begun and its potential was staggering. Yet automation was more than the application of any one or even a combination of these developments. The technology itself was extremely important, yet to achieve its optimum use, a basic reorganization of work both in the office and the factory was required.

The most valuable asset to anyone in planning for automation was a questioning mind. Not only the way things were being done, but the reasons for doing them should be questioned. For every process, there was, at any given time, an optimum degree of automation, which was limited in part by the level of mechanization of the process, and in part by the economic factors involved. It was naïve to approach automation strictly from the labour-saving viewpoint. Although a reduction in direct labour cost was the reason most people gave for considering automation, it was not the only kind of saving, and in many cases not the most important. Just as important were the economies achieved by decreasing waste and improving the quality of the product.

The justification of automation was in many cases that it decreased capital investment per unit of usable output, thus increasing the productivity of capital equipment. In estimating the costs of automation, however, it was misleading to regard capital expenditures as the only consideration. Less immediately apparent, but no less significant, were the costs of analysing, planning and developing the automation system, potential early obsolescence with product change if flexibility was not an inherent part of the system, more highly skilled workers, their training and recruiting as well as higher salaries; and higher maintenance costs. None of these considerations should be interpreted as a disparagement of automation. The saving automation could achieve must more than compensate for its costs and every case must be considered with a regard for its own specific economic conditions.

Planning for automation should be broad enough, and should be done at a high enough level, so that a perspective could be maintained of the "automated" portions in relation to the rest of the operation. Before we even began to consider process changes aimed at achieving automatic production we must question every element in the design of the product to determine if it was thoroughly suited to automation. The product designer must be trained in the new engineering and manufacturing methods of automation, and must work in close co-operation with the machine designer. Furthermore, the process must be rethought as well as the product.

Fundamentally, automation led to simplification of the process. An "automated" line incorporated inspection stations after each change in the product and linked these inspection stations directly to the control of the preceding, and of the subsequent phase. It was impossible to overestimate the importance of regarding the entire process as a system.

Concern had been expressed recently about potential unemployment due to automation. All too often, management was on the defensive when discussing the effect that automation might have on employment. Yet, there was so much to look forward to, automation promised so much for the future that there was no reason to be defensive. For the nation automation would mean greater economic abundance, the creation of new types of products and improved products. Above all, it meant the production of more goods with less effort. For labour, it meant freedom from many of the routine, machine-paced tasks of industry, the very types of jobs which had given rise to the criticism that industrialization had enslaved man and made the machine his master. The new jobs to which automation gave rise afforded more opportunity for workmanship, and offered greater freedom and scope for individual creativity.

Lectures on Automation

A series of six lectures and discussions on "Automation in Industry" is being held at the Polytechnic Hall, Calderwood Street, Woolwich, London, S.E.18, starting on 23rd November and finishing on 21st February. The titles are as follows: "Fundamentals of Automatic Process Control," "Automation in the Office," "Automatic Linking and Transfer Devices," "Automation of Machine Tools," "Automatic Machine and Process Control," and "Automatic Processing in the Petroleum Industry." The lectures commence at 7 p.m. and admission is free; seats can be reserved upon request to the Woolwich Polytechnic.

The Xenon Gas Lamp

AT Film House, Wardour Street, London, W.1, recently Mr. H. W. Cumming, of Siemens Brothers Laboratories, delivered a lecture to members of the British Kinematograph Society on the development of the xenon gas arc lamp for the film and television industries. He explained that because the filling was a permanent gas as distinct from a vapour, no warming-up period was required with xenon lamps; full light output was achieved instantly with switch-on. Nor was it necessary to maintain the lamp in a state of preparedness; lamps could be switched in or out at any time.

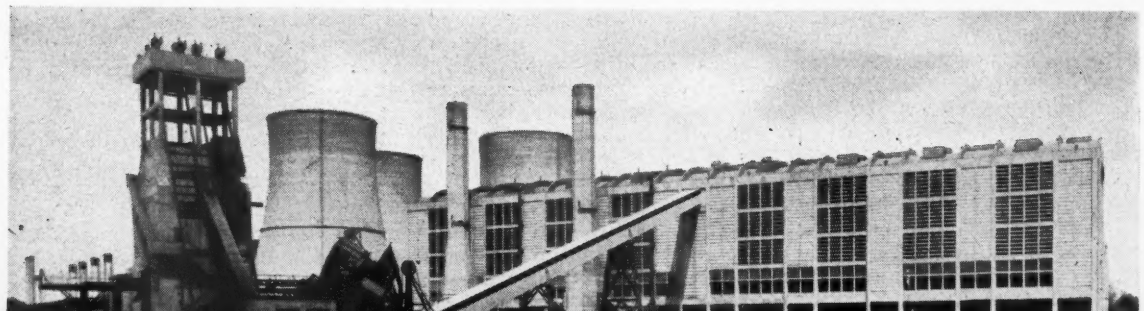
Reference was made to the colour characteristics of the xenon lamp—its broad continuum of emission extending from the infra-red through the whole of the visible region of the spectrum and into the ultra-violet, resulting in a light closely approximating to natural sunlight. The colour temperature of 5,500 deg K was constant even when the light intensity was dimmed. Other advantages of xenon arc discharge lamps were that cool light was available since the surface of the actual radiator was at a low temperature; long periods of operation without attention and adjustment were permissible; and a considerable degree of flexibility in the design of studio lighting equipment was possible since the xenon-arc could be designed either for flood-lighting in the form of relatively long extended sources or, alternatively, as very high brightness short-arc sources for spotlights.

Mr. Cumming explained that the only gas arc lamp likely to supersede carbon arcs for cinematograph projection was the new shorter-arc type xenon lamp of higher loading. A demonstration was given of the projection of 16 mm motion film using this light source—the first demonstration of its kind in this country.

Short-arc xenon lamps, it was explained, could be designed for either a.c. or d.c. operation. In the case of d.c. a supply voltage of 50-60 was adequate and, depending on the means of initiating the arc, even lower voltages could be used. A.c. lamps generally required a high line voltage.

The life of an XC xenon lamp was in excess of six months' service with a daily usage of eight hours and neither adjustment, maintenance, nor service of lamps was required over a very long period of operation.

In conclusion, Mr. Cumming said that the whole phenomenon of high current electric arc discharge through xenon gas had been proved to be capable of producing practical light sources with valuable properties and while some usages had naturally resulted a larger field of application was still awaited.



Construction of 120 MW Thermal Plant in India

THE Ahmedabad Electricity Co., Ltd., serves the Indian city of that name which has a population of 850,000 and whose principal industry is cotton. It was not until 1934 that the company was first able to cater seriously for the potential industrial load, and at that time the original diesel station was replaced by steam plant. This 37·5 MW "A" station was fully loaded by 1940 and during the war the 60 MW "B" station was built. Since then the demand for power has necessitated construction of the 120 MW "C" station in which 45 MW of plant comprising three 15 MW turbo-alternators has already been commissioned.

Because of the steel shortage the station building is entirely of reinforced concrete construction and has overall dimensions of 428ft long by 116ft wide. The building is divided into three sections, the outer two comprising the boiler room and turbine hall while the central section contains at the appropriate levels the boiler feed pump bay, station control room, auxiliary power transformers and switchgear, 500 ton boiler bunkers, raw water and surge tanks, and coal shuttle conveyor. An interesting feature of the building is the shell type roof; the span of the turbine room is 62ft 6in and that of the boiler house 64ft 6in and the thickness of concrete of the roof does not exceed 3ft at mid span. The cladding of the building has been carried out in precast concrete sections only 2½in thick and this made construction a simple and rapid process. At present two concrete chimneys have been erected and each deals with the discharge gases from two boilers.

The coal crusher house showing the end-rock tippler with train marshalling "Beetle" in left foreground

Because of the high temperatures which prevail during the hot weather season (115 deg F is not uncommon) special attention has been paid to the ventilation of the building and this has been complicated by the fact that large numbers of birds attempt to nest inside the station. On the turbine hall side of the building large vertical sunshades have been erected to cast shadows on the main windows and walls, while the boiler house external walls are provided with large louvres behind which expanded metal screens prevent birds from gaining access into the building. Roof ventilation is by means of louvres similarly equipped with screens.

Since 25 per cent of the coal received at the station is delivered in closed wagons an end-rock tippler with a capacity of 200 tons/hr has been installed. This not only inverts the coal wagons, but enables them, when inverted, to be rocked endways, thus permitting the coal in the end portions of the wagons to be freed and discharged from the central doors. Coal train marshalling and handling of wagons to and from the tippler is by means of a Strachan & Henshaw "Beetle" hauling equipment. The entire operation of handling the full and empty wagons is supervised and controlled by the man who operates the tippler itself. No locomotive is employed and only one man is required to uncouple and re-couple the wagons.

Apart from the foregoing, the coal handling plant follows normal practice. After being crushed, coal passes to a short shuttle conveyor from which it can be discharged either to the stock pile or to the main inclined belt conveyor for delivery to the bunker room in the station build-

ing. In the bunker room coal is transferred to a shuttle conveyor from whence it is discharged as necessary to the 500 ton bunker serving each boiler.

Another unusual feature of the station is the provision of means for the thorough wetting of the coal to ensure optimum combustion efficiency. This operation is most important at Ahmedabad where all surface moisture has been dried out of the coal long before it is delivered and where the coal used has a low inherent moisture content. It is also necessary to bind together the large proportion of "fines" which are contained in the coal. The procedure adopted is to give the coal a preliminary wetting by water sprays as it is tipped from the wagons. The second wetting is given on the shuttle conveyor discharging from the crushers, and a final wetting precisely controlled is provided at the bottom of the main inclined belt conveyor taking coal up to the bunker room.

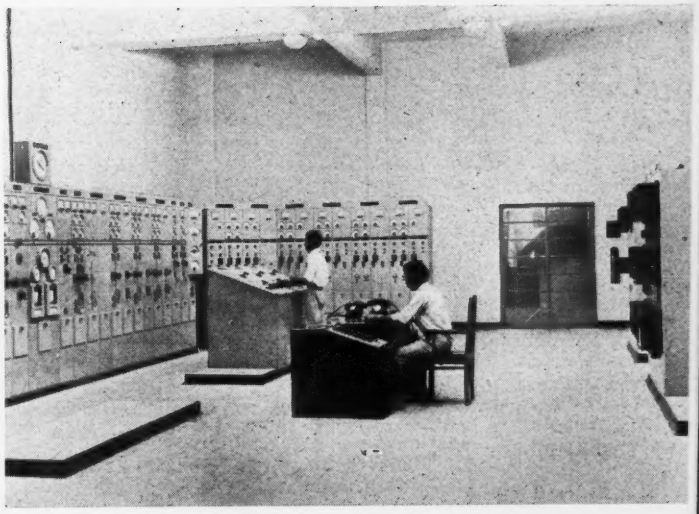
Special attention has also been paid to the stock piling of coal because of the possibility of spontaneous combustion. In the past the company has held its coal stocks under water in large silos, but the installation is expensive and does not lend itself to convenient recovery except by means of a travelling telpher. To overcome this problem a large bulldozer is being used to spread the coal over a large area, and by virtue of its weight to consolidate the stock pile. This minimizes voids in the pile and is a major deterrent to spontaneous combustion. It has been found that the depth can be up to 5 or 6ft without danger and experiments are being continued to ascertain the maximum depth which can be safely used. All coal delivery to the station comes from fields at least 700 miles away and sometimes from as far away as Bengal, which is 1,200 miles from Ahmedabad. In spite of the long haulage the price delivered to site is only about £2 12s 6d a ton.

The boiler plant at present in service comprises four units each having a maximum continuous rating of 170,000 lb/hr at 625 lb/sq in and 850 deg F. The boilers are of the tri-drum type with water-cooled walls and twin louvre underfeed stokers designed to burn low-grade coal. Pendant type superheaters are incorporated, the final steam temperature being regulated by motor-operated dampers. Combustion air to the f.d. fan is taken from the central bay of the building, which greatly assists in the ventilation of the station.

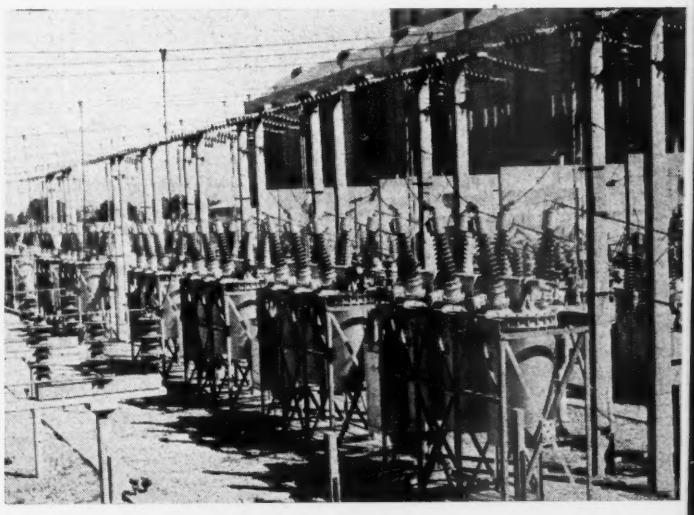
Boiler instrumentation and control conform to modern practice and provision is made for chemical dosing to regulate the pH value of the water, and also for sampling sizes for oxygen content control. The outlet steam from the boilers is controlled by motor-operated valves which admit it to a bus main which feeds independent separators serving each turbine. The boiler feed water arrangements include four electrically driven feed pumps and one steam turbine driven pump as standby, the pumps being connected between the first and second stages of the feed heating equipment.

Although the station is situated on the bank of the Sabarmati River (500 yd wide at this point) it has not been practicable to use the river as a source of cooling water and the entire requirements of the "A," "B" and "C" stations for all purposes are provided for by a number of wells distributed over the site. The raw water used for boiler make-up purposes is passed through low-pressure evaporators, no other treatment being necessary.

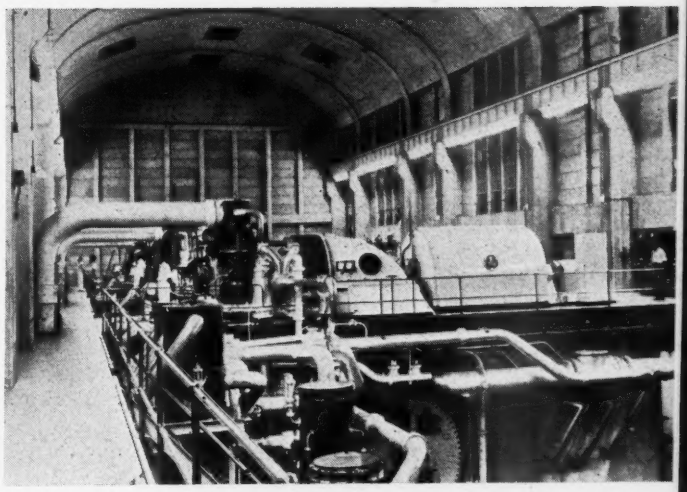
The present cooling tower installation for the new station comprises three reinforced concrete hyperbolic towers, in clover leaf formation, adjacent to one end of the building; three more towers will be added at the opposite end of the building when required. Each tower is capable of dealing with the circulating water from 20 MW of plant and cools the water from 107 to 95 deg F under the worst atmospheric



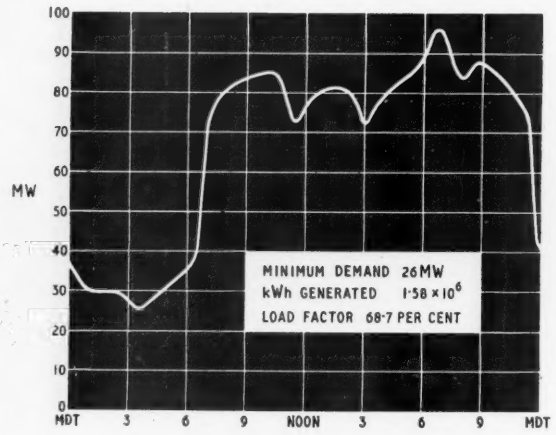
A corner of the main control room



The 66 kV outdoor switching station



General view of the turbine room



Load curve for 7th December, 1954

conditions experienced. The towers are 200ft in diameter at the base and 200ft high, the height being determined by the proximity of the station to Ahmedabad Airport. A feature of the towers is that the louvres and supports are all of concrete, the former being pre-stressed to provide strength and rigidity. Because of the rapid growth of algæ, chlorination of the water has to be applied as a means of control, and in addition to this all water circulation is treated with "Calgon" to deter the accumulation of deposits in the condensers. Undesirable concentration of salts is regulated by appropriate leak-off, the hardness of the water (all temporary) not being permitted to exceed a maximum of 18 deg.

As already indicated, three 15 MW turbo-alternators are installed. Each generates at 11 kV and is solidly coupled to an 18·75 MVA step-up transformer which is connected to the 66 kV switchyard adjacent to the station. Three-stage feed heating is provided to give a final feed temperature of 300 deg F while bled-steam l.p. evaporators deal with raw water make-up to the boilers. The circulating water for the condensers is received from a bus main which is tapped to serve individual machines, thus enabling any c.w. pump to be used at will.

The control room is situated half-way along the central section of the building so that control engineers can see into both the turbine room and boiler firing aisle. In addition to controlling the main 66 kV circuits in the switchyard, all supplies for auxiliaries are controlled from this point, the l.v. transformers and switchgear being situated adjacent to the control room. The layout of this section of the plant is compact and lends itself well to the efficient and ready control of operation. Extensive use of aluminium sheath cables has been made for all auxiliary power supplies and for control circuits.

The design and layout of the 66 kV switchyard follows conventional practice. The circuit-breakers have a rupturing capacity of 1,000 MVA each and are pneumatically operated, by remote control, from the control room, with provision for local operation where required. Provision is made for four outgoing 30 MVA overhead transmission lines (two circuits are now in use) and two interconnectors of 18·75 MVA each to tie the station with the "A" and "B" plants. All oil used in the transformers and switchgear is piped to a central point for cleaning and reconditioning.

Until the new station was erected the primary distribution of energy had been at 11 kV. Further development of this system was found to be uneconomical and some 12 route-miles of 66 kV overhead transmission lines has been installed to serve three outdoor type substations (there will ultimately be four). Each substation is rated at 12·5 MVA at present but this can be doubled when necessary. The output is stepped down to 11 kV and in addition to serving new consumers, picks up load transferred from overloaded sections of the existing network, and by means of tie lines ensures flexibility and interchangeability between the old and the new 11 kV systems. This allows continued expansion in congested areas without resorting to extensive reinforcement and the laying of new cables in those areas.

The very good load factor has resulted in tariff schedules which are easily understood by both the ordinary domestic consumer and the more knowledgeable industrial consumer. The load factor for a normal day is about 70 per cent, the annual load factor being about 62 per cent despite the large number of holidays compared with the United Kingdom; a typical load curve is illustrated.

The principal contractors for the "C" station are:—Gammon India, Ltd., station building, cooling towers, foundations and all civil works; British Thomson-Houston Co., Ltd., turbo-alternators, condensers, feed heaters and evaporators, main and auxiliary switchgear, transformers, control room, relays and metering; International Combustion, Ltd., boilers, stokers, feed pumps, steam and water piping, chemical dosing plant; Strachan & Henshaw, Ltd., coal and ash handling plant, end-rock tippler, "Beetle" haulage; and British Insulated Callender's Cables, Ltd., 66 kV transmission, aluminium-sheathed cables for auxiliary supplies and control cables.

Wood Pole Preservation

THE cause of a large number of failures in recent years of creosoted redwood transmission poles after ten to fifteen years' service and the remedial treatments used to arrest premature decay have been investigated by the Electrical Research Association and a guide to users is provided in Report Ref. O/T17—"The Prevention and Remedial Treatment of Premature Decay in Creosoted Baltic Redwood Poles," by D. N. Smith (price 9s).

Examination of a large number of decayed poles has shown that failure is due to the fact that the outer band of sapwood which is highly susceptible to decay had not been completely penetrated by creosote. The pole specification B.S. 139: 1921 has been replaced by B.S. 990: 1953 which stresses the importance of proper seasoning and the need for complete penetration of the sapwood.

Although comparatively few records have been kept of the service life of properly creosoted pine poles there is sufficient evidence to show that it is possible to obtain a life of the order of fifty years. The report specifies the essential requirements for creosoting poles so that they are capable of giving a long and consistent life and a method is outlined for ensuring that the requirements of the specification are fully met by the provision of an inspection service. At present it is difficult to assess the extent to which remedial treatments in use are beneficial but some indication is given of the steps which should be taken in order to decide whether they are likely to prove successful. Field service trials are now in progress which may give some indication of the value of these treatments.

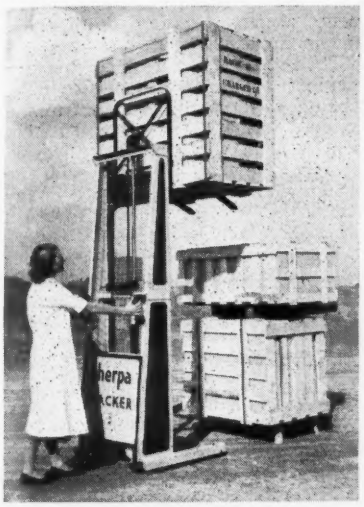
German experience is summarized in E.R.A. Report Ref. O/T18—"German Experience on the Preservation of Wood Poles," by D. N. Smith (price 9s). This describes the preservation of pine poles and some of the views expressed on premature decay and remedial treatment. Bleeding of poles is discussed and also the preservation of spruce poles which are being used to an increasing extent in Germany.

Copies of the reports are available at the prices indicated from the E.R.A. at Thorncroft Manor, Dorking Road, Leatherhead, Surrey.

NEW ELECTRICAL EQUIPMENT

Electric Stacker

The "Sherpa IV" electric stacker available from SALISBURY PRECISION ENGINEERING, LTD., 1, Buckingham Palace Mansions, London, S.W.1, is fitted with a rotary hydraulic pump powered by a 12 V motor, and the



"Sherpa IV" electric stacker (Salisbury Precision Engineering, Ltd.)

heavy-duty traction battery gives 60 lifts with full load for each recharge.

Construction is of steel channel, finished in stoved enamel, adequately stressed to withstand abuse or overload. All working parts are totally enclosed. Easy mobility is provided by two 4in wheels at the front and two 6in castors at the rear. Wheels and castors are of cast iron and fitted with roller bearings. Control is by means of a heavy-duty push-button starter and an infinitely variable release lever. The standard accessories are high tensile steel 24in forks, either straight or ramped, and alternative platforms or gibs are available.

The stacker has a capacity of 7 cwt. The maximum height of lift is 6ft 9in and the minimum turning radius 2ft 6in. A wall mounted battery charger with automatic cut-out can be supplied.

Junction Boxes

A new range of light current junction boxes, designed primarily for use in telephone, public address and signalling systems, but which have many other applications, is now being marketed by COMMUNICATION SYSTEMS, LTD., Strowger House, 8, Arundel Street, London, W.C.2.

Compact in design, the boxes are available in five sizes, and are finished in a hard durable grey enamel. Sufficient room is allowed for the easy arrangement of cables when formed and laced in accordance with normal telephone practice. Ample cable entries, fitted with rubber grommets, are provided so that cables may be run

One of the new range of Communication Systems junction boxes

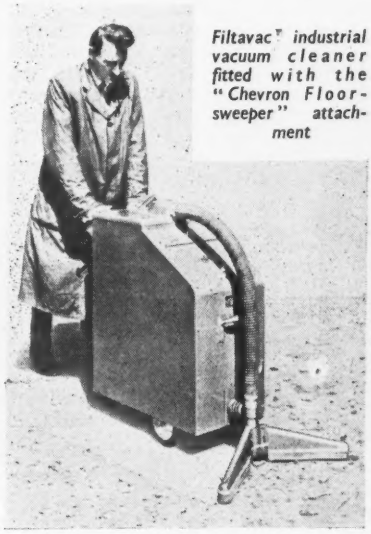
out from either end, and the lids of the boxes have trapped fixing screws. Designation labels are printed on the inside of the lids.

The five sizes, with their respective capacities, are as follows: 15-way, 8in by 4in by 1⅞in; 26-way, 8in by 8in by 1⅞in; 39-way, 8in by 8in by 1⅞in; 52-way, 14in by 8in by 1⅞in; and 78-way, 20in by 8in by 1⅞in.

Industrial Floorsweeper

An attachment for coupling to their model RM22 industrial vacuum cleaner has been developed by FILTAVAC, LTD., 64a, Kensington Church Street, London, W.8. Named the "Chevron Floorsweeper," it enables large-area factory floors and gangways to be swept at a smart walking pace without interfering with production. An adjustable slide incorporated in the tool allows the removal of the usual factory debris.

The floorsweeper is available in three standard widths of 18, 24 and 30in and for extra large floors there is a 50in width for the Filtavac RM44.



Filtavac industrial vacuum cleaner fitted with the "Chevron Floorsweeper" attachment

Shop Window Reflector

The latest addition to its range of fluorescent reflector fittings to be announced by the ENSEL ELECTRIC CO., LTD., 218-219, Upper Street, London, N.1, is the "Eterna" adjustable angle reflector specially designed for shop window lighting. It is available for use with one, two or three 5ft 80 W tubes. The light angle is adjustable by fixing brackets provided at each end of the reflector. Separately housed control gear is required. The finish is in white stoved enamel and supplies are available from stock.

Cathodic Protection Rectifiers

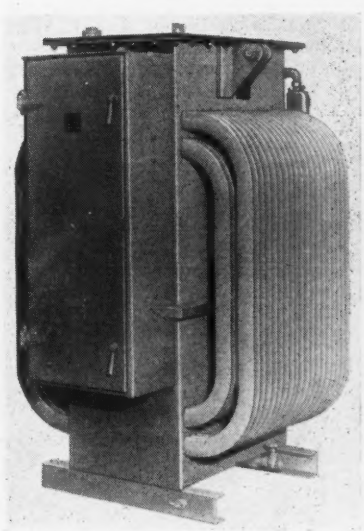
The HACKBRIDGE & HEWITTIC ELECTRIC CO., LTD., of Walton-on-Thames, Surrey, is now supplying metal plate rectifiers for the cathodic protection of buried metal structures.

They are built according to a basic constructional design but the rating and general electrical design are arranged to suit individual requirements. Voltage control is provided either by transformer tapping switches or by a voltage regulating transformer.

The rectifier illustrated is a typical unit for providing a d.c. supply of up to 80 A and 6-60 V at an ambient temperature of up to 55 deg C. It is for the cathodic protection of an oil pipe line in the Middle East.

The rectifier stacks and regulating transformer are oil immersed in a

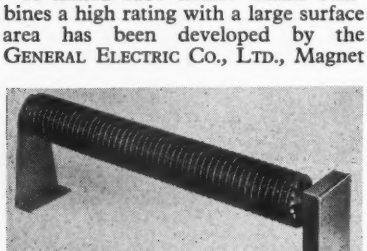
Hackbridge rectifier/transformer unit



weatherproof tank for outdoor service, and the operating handwheel for the regulating transformer together with the measuring instruments and terminals are enclosed in a lockable box to prevent unauthorized interference.

Finned Tube Heater

A finned tube heater which combines a high rating with a large surface area has been developed by the GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, London, W.C.2. It is particularly suitable for industrial ovens and drying rooms where temperatures of 200 to 350 deg F are required. In natural convection ovens working between such temperatures the heater has an operating surface temperature of about 500 deg F.



G.E.C. finned tube heater

The heater comprises a mild steel tube with a crimped gill, of 4in outside diameter. This tube houses a withdrawable element consisting of a spiral, operating at low temperature, carried on insulators which are assembled on a metal runner. The tube is of heavy gauge steel and weighs about 7 lb per foot run. A mild steel connecting box is provided at one end of the heater with a bracket for conduit entry at the base. Automatic temperature controls for controlling room or oven temperature can be supplied.

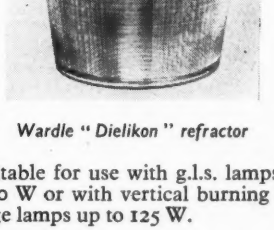
Electric Blanket

The "Sleepwarm" electric safety blanket recently added to their range by FALK, STADELMANN & CO., LTD., 91, Farringdon Road, London, E.C.1, is a single-heat model measuring 50in by 30in, and is supplied in either pink or blue blanket material with matching satin binding. The soft fleecy material is non-ignitable and the asbestos covered element is securely held throughout its entire length by lock stitching. Two "Otter" type thermostats are incorporated for additional safety and it is fitted with 9ft of non-kink flex and with a d.p. on/off switch. The loading is 100 W. It conforms to B.S. 2612 and the price is £5 10s, plus £1 4s 2d purchase tax in the United Kingdom.

Street Lighting Refractors

Designed to give maximum performance in street lighting the new "Dielikon" refractor introduced by the WARDLE ENGINEERING CO., LTD., Elsinore Road, Old Trafford, Manchester, 16, is moulded from "Diakon," an acrylic resin developed by Imperial Chemical Industries, Ltd. This material has great strength combined with lightness and outstanding weathering qualities and it cannot be easily broken. For light control it has proved an ideal material; the performance is stated to be such that a 150 W lamp gives results comparable with a 200 W lamp under normal control.

All the prisms are sealed and are dust- and damp-proof and the exposed surfaces are smooth. The "Dielikon"



Wardle "Dielikon" refractor

is suitable for use with g.l.s. lamps up to 200 W or with vertical burning discharge lamps up to 125 W.

Security Switch

A new device, marketed by BRACE PRODUCTS, 10, Scutari Road, London, S.E.22, is a security switch known as the "Allo." Intended for use on vehicles and machines, it is designed on the combination principle. Inside the switch there are eight radially mounted operating "fingers," the movement of which causes connection to be made or broken with eight electrical contacts. The fingers are controlled by a rotatable selector knob. Certain of the contacts are wired in series into the ignition system, and the remainder wired in parallel to the horn or fuses. On the outside of the switch, visible to the user, there is a dial which indicates by letters the positions of the fingers.

In order to start the car the driver must rotate the control knob anticlockwise into each of the positions corresponding with the contacts wired into the ignition system. He depresses the knob at each position in turn. This pushes the fingers into a position which enables electrical contact to be made, thereby bringing the ignition system into operation.

To disengage the system, the user merely turns the knob clockwise to the "off" position. This causes the engaged fingers to move so that contact with the ignition system is broken. Anyone tampering with the switch who depresses the knob in any one of the "wrong" positions will set off the horn or blow the fuses.

The price of the "Allo" switch is approximately £6 plus purchase tax.

Falk, Stadelmann "Sleepwarm" electric blanket

"Allo" combination security switch

CATALOGUES AND LISTS

CABLES.—Leaflet (EN.201) describing flexible welding cables.—**Enfield Cables, Ltd.**, Victoria House, Southampton Row, London, W.C.1.

DOMESTIC APPLIANCES.—Descriptive folder (H 511-1) illustrated in colour, on the company's rotary ironer.—**Hotpoint Electric Appliance Co., Ltd.**, Fletton, Peterborough.

Sales leaflet in the shape of a Christmas tree describing the company's range of electric dry shavers.—**Remington Rand, Ltd.**, 26-40, Kensington High Street, London, W.8.

HEATING ELEMENTS. — Illustrated descriptive catalogue giving particulars of a range of replacement heating elements, etc., together with a separate price list.—**Genristo, Ltd.**, Osmaston Street, Nottingham.

LIGHTING FITTINGS.—84-page priced and illustrated catalogue describing the range of "Mazda" fluorescent and tungsten lighting fittings, together with a folder on fluorescent fittings.—**British Thomson-Houston Co., Ltd.**, Crown House, Aldwych, London, W.C.2.

Illustrated priced folder of industrial type fluorescent lighting fittings.—**Cryselco, Ltd.**, Kempston Works, Bedford.

MOTOR CONTROL GEAR.—Glossy cut-out in the form of the company's new type "PSC4D" direct switching starter.—**Allen West & Co., Ltd.**, Brighton, 7.

RESISTANCES AND LOAD TESTING EQUIPMENT.—Illustrated brochure describing expanded metal resistances for industrial marine and traction applications. Also leaflet on the company's load testing equipment.—**Expanded Metal Co., Ltd.**, Burwood House, Caxton Street, London, S.W.1.

SWITCHGEAR. — Illustrated 100-page priced catalogue describing the complete range of the company's standard products.—**Wm. Sanders & Co. (Wednesbury), Ltd.**, Falcon Electrical Works, Wednesbury, Staffs.

TELEPHONE EQUIPMENT.—Descriptive brochure (D/TD 16) dealing with the "4406" head telephone set.—**Standard Telephones & Cables, Ltd.**, Connaught House, 63, Aldwych, London, W.C.2.

TEST EQUIPMENT.—Descriptive folder dealing with the "Megger" range of insulation testers.—**Evershed & Vignoles, Ltd.** Acton Lane Works, Chiswick, London, W.4.

GENERATION AND DEVELOPMENT

C.E.A. *Contracts*

Contracts have been placed by the Central Electricity Authority during the past month for power stations, transforming stations and transmission lines, amounting in the aggregate to £3,374,917. The principal contracts include:—

Tilbury power station: High pressure pipework and valves.—John Thompson Water Tube Boilers.

Willington "A" power station, near Derby: Auxiliary service pumps.—Gwynnes Pumps. 132 kV and multicore cables.—Pirelli-General Cable Works.

Rogerstone power station, Mon.: Sidings acommodation.—British Transport Commission, Western Region.

Ealing, London: Two 40 MVA, 66/22 kV transformers.—Fuller Electrical & Manufacturing Co.

Fleet, Hants: 120 MVA, 275/132 kV transformer.—Hackbridge & Hewittic Electric Co.

Coventry South substation: Two 60 MVA, 132/33 transformers.—Hackbridge & Hewittic Electric Co.

Castle Donington, near Derby: 275 kV switchgear.—British Thomson-Houston Co.

Bangor: 45 MVA, 132/33 kV transformer.—Hackbridge & Hewittic Electric Co.

Littlebrook, Hastings: 132 kV overhead line modifications.—W. T. Henley's Telegraph Works Co.

Iver, West Weybridge: 275 kV overhead line.—Balfour Beatty & Co.

Bridgwater, Taunton: 132 kV overhead line.—Riley & Neate.

Carmarthen Bay, Trostree Tee Point: 132 kV overhead line.—Pirelli-General Cable Works.

Rochdale, Nelson: 132 kV overhead line.—British Insulated Callender's Cables.

Stella South, Herrington Burn: 132 kV overhead line.—Riley & Neate.

Postponement of North Western Schemes

A statement issued last week by Sir Joseph Hallsworth, chairman of the North Western Electricity Board, says that while it is not yet possible to indicate the full effects of Government economic policy involving the curtailment of capital expenditure, the Board has already had to defer certain schemes. Between now and the end of March next it is probable that the rate of connecting farms will be only half of what it has been up to now. The previously planned rate of connection for this year was around 900, but this figure will now fall to 700 or less. The number of other rural premises to be connected is expected to fall from about 1,900 to 1,400.

The position in the Lake District is under detailed review. It is already evident, however, that the Borrowdale scheme, under which the Board has decided that the supply shall go underground as far as Rosthwaite, cannot be undertaken in the present financial year, and it is not possible at present to say whether it can be carried out in 1956-57. Among other Lakeland schemes the Board expects the Hartsop project to be finished within the next three months or so, and work is proceeding in Lower Langdale. Several other schemes, such as Ivegill, are in hand. Apart from rural electrification, many other projects previously approved for completion before the end of March, 1956, will suffer also. The change-over from d.c. to a.c., which has been progressing steadily since nationalization, will be adversely affected, as will various network reinforcements and the construction of several substations.

Capital expenditure on buildings for testing stations, workshops, stores and offices will be curtailed. Contracts placed for much-needed service centres will be completed, but further plans for improving the service to the public will be largely deferred. The provision of special tools and equipment for meter and appliance testing and similar purposes will also be retarded. The restrictions will interfere with the extension of the short-wave radio system by means of which the Board has been stepping up the speed of dealing with network breakdowns and faults in consumers' installations and appliances.

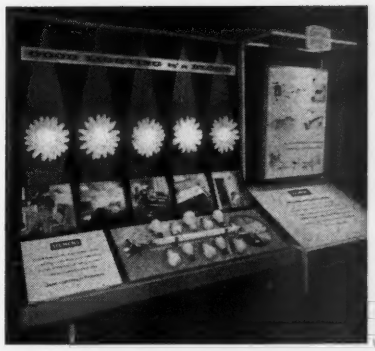
Mr. K. Dobell, chairman of the Lake Planning Board's Development Control Committee, told a *Manchester Guardian* reporter that the decision on the Borrowdale scheme was very disappointing and he thought the Planning Board would protest most violently if it was being put off more or less indefinitely.

Yorkshire Board's Programme

The Yorkshire Electricity Board states that the required reductions in capital and other expenditure will be obtained by economies and a slightly extended period for the execution of the Board's long-term programme of extension and reinforcement of the distribution system and accommodation programme. The Board will meet all existing promises and obligations and its normal services will not be affected.

Showroom Display

Centred around the theme "Good Lighting is a Bloom—a Bloom that Enhances and adds Cheer to the Home," the display unit shown in the accompanying picture is one of six recently delivered by Siemens Electric Lamps & Supplies, Ltd., to the South Eastern Electricity Board. Booked for circuit in the Board's Area, the display is made in two separate sections to cater for various window and showroom positions. The five marguerite blooms are each illuminated in the centre, and photographic reproductions below each flower illustrate good lighting examples in the home. A selection of "Silvalux" lamps, a fluorescent tubular lamp, and reflector spotlight are displayed on the lower panel



Siemens lamp display unit which is being used in the showrooms of the South Eastern Electricity Board

whilst the right-hand unit shows various operations in the precision manufacture of Siemens lamps.

Atomic Power Station Contract

As already briefly reported, the Mitchell Construction Co., Ltd., of Peterborough, has been awarded a £3,500,000 contract by the United Kingdom Atomic Energy Authority for the civil engineering work on the new atomic power station at Chapelcross, Annan, Dumfriesshire. Work will begin next month and is expected to take about 3½ years. The consulting engineers are Merz & McLellan, of London.

Winter Load Conditions

It is not expected that any load shedding will be necessary in the North-East area this winter, unless conditions are unduly severe. This has been announced by the Northern Regional Board for Industry which has had discussions on the matter with the North Eastern Electricity Board. Consumers have been asked to practice economy during the peak periods each day, and firms with private generating plants have been requested to keep them ready for operation if this is necessary.

Proposed New Transmission Line

The *East Anglian Daily Times* reports that, to meet the increasing demands for electricity, it is proposed to construct a 132 kV transmission line from Ipswich to Bury St. Edmunds at a cost of about £200,000. The East Suffolk Planning Committee has recommended that no objection should be made to the proposal.

Complaints by Farmers

Tenterden (Kent) Rural District Council has passed a resolution protesting against electricity failures in its area. A number of farmer-members complained of cuts and of poor supply. Mr. A. G. Cooke (Stone) said that he had been better served when he ran his own plant. Within three weeks of going over to the public supply there had been a failure and some of his equipment had been damaged. Mr. S. A. Bates (Wittersham) said that it cost £1,000 to get a mains supply to his

farm and then he was told that there would not be sufficient power for the equipment he wanted.

Trolley-bus Power Supply

Ever since 1919 the Tees-side Railless Traction Board's trolley-buses have been run on surplus electricity generated at the Cleveland ironworks of Dorman, Long & Co., Ltd., but new developments by the steel company have resulted in their needing the whole of their generating capacity. In consequence, the Tees-side Board is now taking a supply from the North Eastern Electricity Board through a new transformer station which has been built for the purpose at Henry Street, South Bank (N. Yorks). No increase in the cost of running the trolley-buses is anticipated.

Television Relay

Brighton Town Council last week decided by 31 votes to 30 not to approve a recommendation that Relay Circuits, Ltd., should be granted a monopoly concession for a wired television service in the town for a period of ten years. The other competing company was Rediffusion, Ltd.

Electricity in Nigeria

About 300,000 Nigerian families will be supplied with electricity when the £1½ million Oji River project is completed. This was revealed by Sir Clement Pleass, Governor of the Eastern Region of Nigeria, in reply to an address of welcome presented to him by the Awgu District Council. The Governor stated that the power station would ultimately have a capacity of 30 MW and that one-third of the project, which had been completed, would supply Enugu, Awka, Onitsha and Abakaliki with electricity.

STREET LIGHTING NOTES

WANDSWORTH Borough Council is recommended to approve schemes for the installation of sodium lighting in 358 residential roads and a number of public footpaths. The estimated cost of the proposals is £189,439.

Subject to the approval of the Ministry of Transport and Civil Aviation, EALING Highways Committee recommends the invitation of tenders for street lighting along the unlit section of Western Avenue from Ealing Road to Islip Manor Road. The estimated cost is £7,600.

Acceptance of the quotation of the South Wales Electricity Board for the carrying out of the third section of BARRY Corporation's scheme for main traffic route lighting is recommended. The estimated cost of the scheme is £12,200.

A mercury lighting scheme has recently been completed in the Great West Road at CHISWICK with the installation of 112 Mazda "Sapphire" lanterns by the Brentford and Chiswick Borough Council. The mercury vapour enclosed reflector lanterns, housing 400 W lamps, are side-entry mounted on concrete columns at a height of 25ft, spaced at central and staggered intervals of 120ft. The lanterns are made of silicone aluminium alloy and all exposed parts are fully corrosion resistant. The rippled glass diffusing bowl is designed to be self-cleaning in rain. The contractors were the North Midland Engineering Co.

Conversion of public lighting from gas to electricity in the residential roads at BRIDGWATER during the next two years, instead of three, is recommended by the Highways Committee, and it is proposed to test a new type of sodium lantern for the narrow streets. The estimated cost of the first year's programme is £7,850 and of the second £7,650.

CHESTER Corporation has approved, subject to the issue of the necessary loan consents, the scheme of the Merseyside and North Wales Electricity Board for the conversion of the street lighting in Hoole from gas to electricity at a cost of £11,294.

The improvement of street lighting in Brook Street, part of Reading Street, part of Basing Road and in Eastrop Lane, BASINGSTOKE, is estimated to cost £2,133.

A good example of street lighting design can be seen in COVENTRY. With the ultra-modern store of Owen Owen, Ltd., as a background, the Siemens "Kuwait" and "Coventry" (double version of the "Kuwait") lanterns demonstrate that fluorescent street lamps need be neither ugly nor bulky. The standards conform equally well with older buildings. Both the "Kuwait" and "Coventry" lanterns are mounted on Stewarts & Lloyds Gb.965 lighting columns. No bracket arm is required as the lanterns simply fit into the column by a spigot. Three 5ft 80 W "Sieray" fluorescent lamps are housed in each lantern.

Siemens "Kuwait" and "Coventry" lanterns blend well with the modern exterior of this Coventry store

For the lighting of the Great West Road at Chiswick "Sapphire" lanterns are used

DODWORTH U.D.C., Yorks, is seeking permission to borrow £4,500 for the improvement of the street lighting in the village.

The Ministry of Transport has approved THORNABY Town Council's plans to install sodium lighting in Lanehouse Road, George Street and Westbury Street, Thornaby.

HORNSEY Borough Council is recommended to approve the conversion of street lighting from gas to electricity in two stages, at an estimated cost of £20,000.

NEXT WEEK'S EVENTS

Organizers of electrical functions are advised to make use of the "Electrical Review" clearing house, Room 221, Dorset House, Stamford Street, London, S.E.1, to ascertain that proposed dates for their functions do not clash with others already arranged

Monday, 21st November

BRISTOL. — S.W.E.B., Colston Avenue, 6 p.m. I.E.E. Western Supply Group. "Automatic Circuit Reclosers," by G. F. Peirson, A. H. Pollard and N. Care.

CHESTER.—Town Hall, 6.30 p.m. I.E.E. Mersey & North Wales Centre. "Control of d.c. Machines," by E. P. Hill and A. A. L. Bentall.

GLASGOW. — 39, Elmbank Crescent, 7.30 p.m. Institute of Industrial Supervisors, Glasgow Section. "Isotopes in Industry," by Dr. H. Seligman. (Joint meeting with I.W.M.)

IPSWICH. — Electric House, 7.15 p.m. Ipswich & District Electrical Association. "Analytical Approach to Industrial Lighting," by W. Imrie-Smith.

LEEDS.—24, Aire Street, 6.15 p.m. I.E.S. Leeds Centre. "Prevention of Blindness," by G. Black.

LONDON.—Savoy Place, W.C.2, 5.30 p.m. I.E.E. Radio & Telecommunication Section. Discussion on "The Reception of Band I and Band III Television Programmes," opened by E. P. Wethey.

Imperial College, South Kensington, 6.15 p.m. Institute of Metal Finishing. "The Use of the Electron Microscope in Electrochemical Research," by A. Mohan, "The Application of Technical Studies to Industrial Experience," by D. I. C. Kapp and "The Kinetics of Electrodeposition of Metals," by D. M. Gilbey.

MANCHESTER.—Nag's Head Hotel. Electrical Trades' Commercial Travellers' Association, North Western Branch. Annual general meeting.

NEWCASTLE-UPON-TYNE.—King's College, 6.15 p.m. I.E.E. North-Eastern Radio & Measurements Group. "Electrical and Magnetic Measurements in an Electrical Engineering Factory," by D. Edmundson.

STAFFORD.—Swan Hotel. I.E.E. North Staffs. Students' Section. Students' Lecture: "Attitudes of Mind," by A. R. Cooper.

Tuesday, 22nd November

CAMBRIDGE. — Technical College, Collier Road, 6.30 p.m. I.E.E. East Anglian Sub-Centre. "A Criterion of Distribution Cost," by D. J. Bolton.

COVENTRY.—Methodist Central Hall, Warwick Lane, 7 p.m. I.E.E. South Midland Students' Section. "Telecommunications in the West Indies," by S. Gibson.

Coventry Electric Club. "Lighting in the Film Industry," by W. R. Stevens.

LEEDS.—1, Whitehall Road, 6.30 p.m. I.E.E. North Midland Utilization Group. "Timing the Operation of Control Systems associated with Rotating Equipment," by C. Cuthbert and D. A. Picken and "The Dynamic Braking of Induction Motors," by Dr. D. Harrison.

LIVERPOOL.—9, The Temple, Dale Street, 6 p.m. I.E.S. Liverpool Centre. "Studies in Interior Lighting," by J. M. Waldram. (Joint meeting with the R.I.B.A.)

LONDON.—Savoy Place, 6.30 p.m. I.E.E. London Graduates' & Students' Section. "Electrical Measurement of Mechanical Vibrations," by D. E. Mullinger.

Lighting Service Bureau, 2, Savoy Hill, 6 p.m. Illuminating Engineering Society. "Ship Lighting," by T. Catten.

LOUGHBOROUGH.—The College, 6.30 p.m. I.E.E. East Midland Centre. "The Electrical Engineering Industry in the Post-War Economy—II," by G. L. E. Metz.

MANCHESTER. — Engineers' Club, Albert Square, 6.15 p.m. I.E.E. North-Western Measurement & Control Group. "A New Meter for the kVA Demand Charge," by P. Baxter.

RUGBY.—College of Technology & Arts, 6.30 p.m. I.E.E. Rugby Students' Section. Students' Lecture: "Attitudes of Mind," by A. R. Cooper.

Wednesday, 23rd November

BARROW-IN-FURNESS. — N.W.E.B., Demonstration Theatre, Duke Street, 7.15 p.m. I.E.E. North Lancashire Sub-Centre. "Design, Performance and Application of Miniature Circuit-Breakers," by H. W. Wolff and T. G. F. Atherton.

GLASGOW.—39, Elmbank Crescent, 7 p.m. I.E.E. South West Scotland Sub-Centre. "Highland Water Power," by the late T. Lawrie. Paper to be read by an officer of the North of Scotland Hydro-Electric Board.

LONDON.—Savoy Place, W.C.2, 5.30 p.m. I.E.E. Supply Section. "Flat Pressure Cable," by J. S. Mollerhoj, A. M. Morgan and C. T. W. Sutton.

Waterloo Bridge House, 5 p.m. Institution of Post Office Electrical Engineers, London Centre. "English in the Engineering Department," by L. S. Hughes.

At the Royal Society of Arts, John Adam Street, 2.30 p.m. Royal Society of Arts. "Research in Industry," by Dr. B. K. Blount.

SALISBURY.—S.E.B. Showrooms, 6.30 p.m. I.E.E. Southern Centre. Informal lecture on "The Recent Search for and Salvage of the Comet Aircraft near Elba," by Cdr. C. G. Forsberg, R.N., and G. G. MacNeice.

Wednesday, 23rd November, to Saturday, 26th November

LONDON. — Royal Hotel, Woburn Place, W.C.1. Radio Society of Great Britain. Annual Amateur Radio Exhibition.

Thursday, 24th November

BIRMINGHAM.—James Watt Institute, Great Charles Street, 6 p.m. Institute of Fuel, Midland Section. "Industrial Aspects of the Beaver Report," by G. Nonhebel.

LIVERPOOL.—9, The Temple, Dale Street, 7 p.m. Institute of Fuel, Merseyside Sub-Section. "Some Problems in Domestic Heating," by J. S. Hales. (Joint meeting with the National Smoke Abatement Society, North-Western Division.)

LONDON.—Connaught Rooms, W.C.2, 12.30 for 12.55 p.m. Batti-Wallahs' Society. Luncheon. Address by Mr. A. Boyle.

Friday, 25th November

BATH.—S.W.E.B., Old Bridge Street, 7 p.m. I.E.S. Bath & Bristol Centre. "The Maintenance of Lighting Installations," by A. D. S. Atkinson.

BIRMINGHAM.—Regent House, St. Philip's Place, Colmore Row, 6 p.m. I.E.S. Birmingham Centre. "Germicidal Radiation," by D. H. Holloway.

CARDIFF.—St. Mellons Country Club. I.E.S. Cardiff Centre. Annual dinner-dance.

LEICESTER. — Coronation Hotel. I.E.S. Leicester Centre. Social evening.

LONDON.—Connaught Rooms, W.C.2, 5.30 for 6 p.m. Electrical Power Engineers' Association. Annual dinner.

21, Albemarle Street, 9 p.m. Royal Institution of Great Britain. "Lightning and the Long Electric Spark," by Dr. B. F. J. Schonland.

Pepys House, 14, Rochester Row, 7 p.m. Junior Institution of Engineers. Annual general meeting.

NOTTINGHAM.—Welbeck Hotel, 7.15 p.m. I.E.E. East Midland Centre. Dinner-dance.

PETERBOROUGH.—Campbell Hotel. Incorporated Plant Engineers, Peterborough Branch. Annual dinner.

SHREWSBURY. — Lion Hotel, 7.30 p.m. Institution of Production Engineers, Midlands Region, Shrewsbury Section. Annual dinner-dance.

WEYMOUTH.—South Dorset Technical College, 6.30 p.m. I.E.E. Southern Centre. "Atomic Energy," by H. Lysons.

Saturday, 26th November

BLACKPOOL.—Cliffs Hotel, 6.15 p.m. I.E.E. North Lancashire Sub-Centre. Dinner-dance.

LONDON.—I.E.E. London Graduates' & Students' Section. Visit to St. Bartholomew's Hospital (X-Ray Department—Diagnostic) at 10 a.m.

A.S.E.E. South-West London Branch. Evening visit to Carmelite House. (Production of *Sunday Dispatch*.)

PORTSMOUTH. — A.S.E.E. Southampton Branch. Visit to Brickwoods Brewery, Portsmouth.

The Economic Situation

The Grand Council of the Federation of British Industries, following the Budget statement of the Chancellor of the Exchequer, has reviewed the economic situation and has issued a statement in which it refers to the Chancellor's decision to restrict credit, and his announced reductions and limitations in Government and local authority capital expenditure programmes. It supports the Chancellor's request that individual companies—and also the managements of nationalized industries—should follow his lead by taking under review their own capital programmes, and postponing for the time being items not vital to the needs of the export trade or to the maintenance of basic development of their business. The Federation believes that the anti-inflationary effects which the purchase tax increases are intended to have could be better obtained by a further reduction of Government expenditure. It states that the increase in profits tax can have no noticeable influence on the attack on inflation, and can only extend those economic distortions which were pointed out in the Majority Report of the Royal Commission on Taxation.

It considers that the most serious aspect of the situation now is the threat of widespread claims for heavy increases in wages, for the effect of these if granted must be to establish an inflation even greater than that which has led to the Government's corrective measures. A large increase in wage costs could only have calamitous effects on competitive power, and the need to avert this appears to the Federation to be paramount. The Federation says that it is a time when special care and restraint are required from all ranks in industry, and the Federation feels it proper to urge its members to avoid increases in prices wherever the level of costs leaves a choice open in the determination of selling prices.

Financial Section

STOCKS and SHARES

MOST sections of the Stock Exchange have continued to act uncertainly under the combined influence of foreign affairs, domestic wage claim prospects and the workings of the Treasury's tight money policy. In the first ten days of this month the gilt-edged market suffered as sharp a relapse as most people can remember, with War Loan falling from 78 to 73½ at one time, and touching in the process the lowest points for more than three years. A brisk revival followed news of the encouraging overseas trade figures for October. War Loan had picked up to 76 by the beginning of this week. Industrials followed the gilt-edged lead, although the fluctuations were comparatively restrained.

New Issues

Investors prepared to take on new commitments in the present circumstances of the industrial market are being freely advised to pay attention to the shares of the companies engaged in offering large amounts of new capital to their shareholders on "rights" terms. In many cases, the view is held that the selling of these rights by holders, unable or unwilling to pay for their provisional allotments, is having the effect of depressing out of line the shares concerned with investments of similar standing. The new £1 ordinary shares issued by Tube Investments and B.I.C.C. are cited as current examples. At all-in prices respectively of 55s 6d and 48s (free of stamp to the buyer) the prospective yield in both instances exceeds 5 per cent, a return difficult to find, even now, in the top flight of industrials.

A. H. Hunt Issues

New 4s ordinary shares of A. H. Hunt (Capacitors) have been changing hands at a premium of about 3s 6d on the price of 16s 6d at which they were offered to the company's shareholders. They became fully-paid this week, and will be available free of transfer stamp until the early part of next month. Regarding dividend prospects, the directors are expecting that current profits will justify a final dividend, on the increased capital, of the same amount as last year's. Before this payment, capital will have been doubled by a scrip issue to be distributed in about a month's time. Assuming a proportionate reduction in the rate of the 27½ per cent paid in total for 1954, the prospective yield on the shares at a price of 20s is 5½ per cent.

By the cash issue noted above, A. H. Hunt (Capacitors) are raising close on £200,000 for use, among other purposes, in the erection and equipment of a new factory and in increasing mechanization at two others. The additional working capital, to finance the expansion of turnover expected from these developments, will come from the company's own resources, including retained profits. Issued capital of the company, including the new shares now in the market, is £429,000 (all in ordinary shares), which is to be doubled by the coming scrip issue. The financial year

The Week's Price Changes

Company or Board	Nom. Value	Middle price 14th Nov.	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield %	1955 Highest	1955 Lowest
Gilt edged Stocks						£ s d		
Brit. Elec. 1968/73	100	79½	−2	3	3	3 15 6	94⅜	76½
Brit. Elec. 1974/77	100	77½	−2	3	3	3 17 6	93⅛	75½
Brit. Elec. 1976/79	100	82½	−2	3½	3½	4 4 9	98⅜	80½
Brit. Elec. 1974/79	100	93½	−1	4¼	4¼	4 11 0	109	90½
Overseas Electric Supply								
Calcutta Elec.	£1	20/9	−9d	6†	6†	5 15 9	22/6	20/9
East African Power	£1	21/3	−6d	7	7	6 11 9	24/6	19/9
Nigerian Elec.	£1	21/6	+6d	10	10	9 6 0	27/-	21/-
Palestine Elec. "A"	£1	21/-		Nil	Nil	Nil	22/9	21/-
Perak Hydro-Elec.	£1	22/-		10	10	9 1 9	22/3	17/9
Equipment and Manufacturing								
Aberdare Cables	5/-	12/6		12½	17½	—	14/6	11/-
Aerialite	1/-	6/-	−3d	88½	45*	7 10 0	6/7	5/3
Allen, W. H.	£1	73/9		20	20	5 8 6	83/9	75/-
Aron Elec. Ord.	£1	55/6		15	15	5 8 0	63/9	55/6
Assoc. Elec. Ord.	£1	76/6		11¼	14	3 13 3	96/-	62/6
Automatic Tel. & El.	£1	61/3		15	15*	4 18 0	79/6	60/-
Babcock & Wilcox	£1	76/3	−2/6	12*	15	3 18 9	98/-	68/6
Baldwin, H.	2/-	5/-		20	20	8 0 0	5/6	4/4
Bakelite	10/-	33/-		12½	16	4 17 0	34/6	27/-
British Aluminium	£1	46/3	−2/-	10	12	5 3 3	58/-	35/3
B.I. Callender's	£1	48/-	+1/6	10	12½‡	5 4 3	55/3	44/9
B.I. Callender's 6% Pref.	£1	23/6		6	6	5 2 2	26/6	21/9
British Thermostat	5/-	30/-		27½	27½	4 11 9	35/-	22/6
British Vac. Cleaner	5/-	6/6		25	30	—	10/-	6/6
Brook Motors	10/-	43/9		20	20*	4 11 6	46/3	39/9
Brush Ord.	5/-	7/6		6	10	6 13 3	9/6	7/6
Bulgin, A. F.	1/-	6/9	−3d	30	45	6 13 4	8/-	4/-
Burco Dean	5/-	12/-	−3d	—	—	—	17/3	12/-
Chloride El. Storage	£1	64/6	−1/9	12½	17½	5 8 6	77/6	58/6
Clarke Chapman	£1	92/6		20	20*	4 6 6	102/6	68/9
Cole, E. K.	5/-	19/6	−1/-	27½	17½*	4 9 9	25/6	18/3
Cossor, A. C.	5/-	9/-	−6d	10	15	8 6 8	14/-	8/9
Crabtree	10/-	29/-		20	20	6 18 0	34/6	27/6
Crompton Parkinson Ord.	5/-	16/-		20	16*	5 0 0	19/9	15/-
De La Rue	5/-	20/-	−9d	20	30	7 10 0	26/-	17/-
Decca	4/-	37/6	−1/3	35	56¼*	—	48/9	31/-
Desoutter	5/-	31/3		20	25	4 0 0	35/-	25/6
Dewhurst	2/-	11/-		19	24	4 7 3	11/-	7/3
Dictograph Tel.	2/-	7/6		20	20	5 6 9	9/3	6/6
Dubilier Condenser	1/-	4/6		25	25*	5 11 0	5/7	3/1
E.M.I.	10/-	25/3	−1/-	10	15	5 18 9	37/-	25/3
Electrical Components	5/-	13/9		20	25	9 1 9	21/3	13/9
Elec. Construction	£1	28/9	−1/3	15	8¼*	5 18 3	41/3	28/9
Enfield Cable Ord.	£1	18/6	−1/6	Nil	Nil	Nil	25/3	18/6
English Electric	£1	60/-	−1/6	10	12½	4 3 4	86/9	54/3
English Electric 3¾% Pref.	£1	14/6		3¾	3¾	5 3 6	16/9	14/-
Ericsson Tel.	5/-	40/-	−9d	25†	25*†	3 2 6†	46/6	29/-
Ever Ready	5/-	32/-	−1/-	40	35*	5 9 4	38/-	22/3
Falk Stadelmann	£1	47/6		15	17½	7 7 3	52/6	42/-
G.E.C. Ord.	£1	60/6	−1/-	12½	14	4 12 6	80/3	51/3
G.E.C. 6½% Pref.	£1	25/3		6½	6½	5 3 0	28/4	23/6
General Cables	5/-	15/9		30	30	9 10 6	17/-	15/-
Greenwood & Batley	£1	47/6	−2/6	17½	17½	7 7 4	57/6	47/6
Hackbridge Cable	5/-	23/-	+9d	20	25	6 8 8	22/9	14/-
Hackbridge & Hewittic	5/-	20/6	−3d	25	30	—	24/9	17/-
Hall Tel. Acc.	10/-	31/-		10	10	3 4 6	31/-	11/-
Heatrae	2/-	5/-		12½	15	6 0 0	5/9	4/3
Henley's	10/-	16/9		10½	10½	6 5 6	21/3	15/9
Holophane	5/-	18/9		25	30	—	19/9	16/-

* After scrip issue. † Free of income tax. ‡ Dividend forecast.

The above quotations are based upon middle prices in the Stock Exchange Daily Official List

ends with the calendar, and the results appeared last time in March.

Lucas Results

In maintaining the ordinary dividend at a total of 7½ per cent, which is equivalent to the rate for the previous year, Joseph Lucas (Industries) recently disappointed the more optimistic of previous estimates. The latter had presumably been counting on the accrual of benefits from rising activity in the motor-car world and from the uncommonly wide margin between the company's earnings and the amounts distributed in dividends. Upon the announcement, the price of the £1 shares was marked down by about 3s to 39s, but later made a partial recovery to 40s, at which level the yield works out at approximately 3¾ per cent. From the preliminary profits statement it is evident that the payment remains heavily covered by the year's net surplus.

...in Electrical Investments

Company or Board	Nom. Value	Middle price 14th Nov.	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield %	1955 Highest	1955 Lowest
Equipment and Manufacturing—continued.						£ s d		
Hoover	5/-	37/6	−6d	45	70	9 6 9	52/6	35/6
I.C.I.	£1	48/-	−9d	15	10*	4 5 0	61/9	38/3
Intl. Combustion	5/-	18/-		20	25	—	24/6	16/-
Johnson & Phillips	£1	40/9	+1/3	15	15	—	52/6	39/6
Lancashire Dynamo	£1	45/6		14	15	—	56/6	37/3
Laurence, Scott	5/-	16/3	+3d	20	12½*	3 17 0	19/6	14/6
Lister, R. A.	£1	28/9		12	9·3*	6 9 0	40/-	28/9
London Elec. Wire	£1	50/9	−1/-	10	12½	4 18 6	61/3	50/6
Lucas, J.	£1	40/-	−2/6	7½	7½	3 15 0	56/6	38/9
Marryat & Scott	2/-	10/3		25	30	5 17 0	13/-	9/6
Mather & Platt	£1	60/9		15	13·4*	—	75/-	48/-
Metal Industries	£1	25/-	−9d	9	9	7 4 0	38/-	25/-
Midland Elec. Mfg.	£1	50/-		15	10*	4 0 0	55/-	44/-
Morphy-Richards	4/-	28/3		35	50	7 1 6	35/-	27/-
Murex	£1	60/9	−1/3	15	20	6 11 9	66/-	49/3
Newman Ind.	2/-	2/9		10	10	7 5 6	3/6	2/4
Oldham & Son	1/-	3/-		17½	20	—	3/6	2/1
Parnall (Yate)	5/-	8/6		8	14	8 4 9	13/2	7/3
Parsons, C. A.	£1	73/9	−2/6	7½	10	2 14 3	100/-	56/-
Plessey	10/-	72/6		30	27*	3 15 0	89/-	57/6
Pye Deferred	5/-	20/-	−2/-	20	12½*	3 2 6	32/9	14/3
Revo	10/-	13/-		9	9	6 18 6	15/6	12/6
Reyrolle	£1	95/-		13⅓	15	3 3 3	127/6	89/-
Rheostatic	4/-	12/3		20	22½	—	14/3	9/3
Richardsons Westgarth	5/-	16/-	+1/-	15	16⅔	5 4 3	19/-	11/-
Scottish Cables	4/-	16/9	+6d	27½	27½	6 11 3	22/6	16/3
Smith (England), S.	4/-	15/-	−6d	17½	17½	4 7 6	20/-	15/-
Southern Areas	£1	30/6		7½	10	6 11 3	38/-	27/6
Strand Elec.	5/-	8/3	+6d	17½	15*	9 1 9	13/3	7/6
Sturtevant	5/-	30/-		18·9	14·4†*	2 8 0†	35/9	21/-
Sun Elec.	£1	35/-		15	20	—	35/-	33/9
Switchgear & Cowans	5/-	15/-		10	20	6 13 3	17/-	11/-
Taylor Tunnicliff	5/-	13/9		12½	15	5 9 0	16/3	11/3
T.C.C.	10/-	43/9	−1/9	30	25*	5 14 3	53/9	41/-
T.C. & M.	£1	29/6	−6d	8½	8½	5 15 3	40/9	29/3
Telephone Mfg.	5/-	8/3		10	10	6 1 3	11/6	7/9
Thorn Elec.	5/-	20/-	−2/-	20	15*	3 15 0	33/-	13/9
Thornycroft	£1	45/-		15	15*	6 13 3	47/6	34/6
Tube Investments	£1	55/-	−2/6	22½	14*‡	5 1 9	60/-	55/-
Vactric	5/-	16/3		10	15*	4 12 3	22/-	12/-
Veritys	5/-	10/3	−3d	12½	12½	6 2 0	12/2	7/-
Walsall Conduits	4/-	14/-		70	70	—	17/3	12/-
Ward & Goldstone	5/-	35/-		50	30*	4 5 9	45/-	32/6
Watford	2/-	7/-		22½	25	—	8/9	6/3
Westinghouse Brake	£1	86/3		16	18	4 3 6	110/-	82/-
West, Allen	5/-	12/9	−3d	17½	15*	5 17 9	16/6	8/-
Wolf Electric	5/-	22/-		17½	20	4 11 0	22/-	16/1
Trusts, Transport and Communications								
Anglo-Am. Tel.:								
A. Ord.	100	74½		6	6	8 *1 10	88	67½
Ord.	100	45		3⅜	3⅜	8 6 8	54½	45
Anglo-Portuguese	£1	24/6	+6d	8	8	6 10 9	27/-	21/-
Brit. Elec. Traction:								
Def. Ord.	5/-	19/-	−1/-	50	22½*	5 18 6	24/3	19/-
Cable & Wireless:								
Ord.	£1	41/3	−3d	9	10	4 17 0	54/-	39/6
4% Loan	100	92½		4	4	4 6 6	100	92
Calcutta Trams	£1	26/3	+6d	6†	7½†	5 14 3†	26/3	20/-
Cape Elec. Trams	£1	18/9		5½	7½	8 0 0	19/6	16/6
Marconi Marine	£1	31/3		10	10	6 8 0	41/3	31/3
Oriental Tel. Ord.	1/-	80/9	−1/9	16	—	—	102/6	72/6
Telephone Rentals	5/-	11/3		10	12½	5 11 0	13/6	9/6

Good Results

On the basis of the preliminary profits statement for the year to June last, the Plessey Company's total dividend of 27½ per cent involves the distribution of less than one-sixth of the net profit. With the latter showing another strong advance, from just over a million to £1·4 million after tax, the payment is being raised from 20 per cent. Best expectations were satisfied. At the present price of the 10s shares, 72s 6d, the yield now works out at about 3¾ per cent. S. Smith & Son are keeping the dividend for the latest year at a total (as before) of 17½ per cent, covered 4½ times by earnings. With the aid of a lower tax charge, the net surplus is up from £1·1 to £1·3 million. At 15s 3d the 4s shares yield 4·6 per cent. Johnson & Phillips £1 shares hardened to 40s 9d on the company's interim report of a substantial improvement in the current year's trading.

K. G. (Holdings)

An active market developed in the 1s ordinary shares of K. G. (Holdings), and after a rise from 1s 9d to 3s 9d, they came back to 3s 6d. The activity was promoted by the appearance of the company's full annual report, which gives an outline of further development intentions. Originally a rubber growing enterprise, the company sold its plantations in 1952 and subsequently invested the proceeds in the acquisition of subsidiaries engaged in electrical and mechanical engineering and contracting. For 1954 the company made a profit of £38,000, and is paying a 12½ per cent dividend on the £82,000 ordinary capital.

Interim Payments

In raising the interim dividend on account of the current year from 8 to 10 per cent, De La Rue advise stockholders that this should not be read as indicating a larger total for the full period. No qualifications accompanied the Ward & Goldstone declaration of an increase in the interim from 10 to 12½ per cent, and the shares were well maintained after the news at 35s. This company has a notably conservative dividend record. Shareholders have received successive increases over the past six years, but in none of them has the amount distributed exceeded a quarter of the net profit available. Telephone Manufacturing shares were also supported on the repetition of the interim at 2½ per cent on increased capital.

REPORTS and DIVIDENDS

Reliance-Clifton Cables & Industrial Products, Ltd.—An extraordinary meeting will be held on 30th November at which resolutions for the reorganization and increase of capital will be submitted. It is proposed to sub-divide the 5,250 issued ordinary shares and the 170,000 unissued ordinary shares of £1 each into 701,000 ordinary shares of 5s each; to convert the 21,000 issued ordinary shares of 5s each into ordinary stock; to increase the capital to £1,000,000 by the creation of 1,000,000 "A" non-voting ordinary shares of 5s each; and to convert 120,000 of the 680,000 unissued ordinary shares of 5s each into "A" non-voting ordinary shares. A sum of £280,000 of reserves is to be capitalized in 1,120,000 5s "A" non-voting ordinary shares and issued to ordinary stockholders in the proportion of one new share for each 5s of ordinary stock held. There will remain unissued 114,810 preference shares of £1 each and 560,000 ordinary shares of 5s each. The company states that it has ample funds to cover all foreseeable expenditure and the directors have no present intention of issuing these shares. Treasury consent has been obtained to the issue.

Relay Exchanges, Ltd.—New capital of £275,000 is being raised by an issue of ordinary shares and the private placing of a second series 6 per cent unsecured convertible loan stock, 1962-65. The loan stock is being placed at 96½ by Philip Hill, Higginson & Co. to an amount of £175,000, 25 per cent of which is convertible up to 31st December, 1958, into ordinary shares at the rate of 20s per share of 5s. The offer of ordinary shares consists of 212,500 5s shares at 10s each to existing ordinary shareholders and to holders of the existing loan stock in respect of the unconverted portion of their holdings. The basis of the issue is one new share for every ten ordinary shares held, or which would have been held if the loan stock had been converted.

Scottish Cables (South Africa), Ltd.—Presiding at the annual meeting held in Pietermaritzburg, Natal, on 2nd November, Mr. W. Fraser (chairman) said that the volume of output during the year under review was greater than for the previous year, but the margin of profit was less. An improvement took place during the second half of the year, particularly concerning incoming orders, and the company had made a good start for the current year.

George Cohen Sons & Co., Ltd., are holding an extraordinary meeting on 7th December at which the following resolutions will be submitted:—That the nominal capital be increased to £4,000,000 by the creation of 4,000,000 ordinary shares of 5s each (ranking in all respects *pari passu* with the existing 5s ordinary stock units including the right to all dividends declared subsequent to the date of the meeting); that £1,000,000 (£500,000 from general reserve and £500,000 to the credit of profit and loss account) be capitalized in paying up in full at par the 4,000,000 ordinary shares to be allotted and distributed credited as fully paid up in the proportion of two ordinary shares for every three ordinary stock units held.

Yarrow & Co., Ltd., report that after providing £215,000 for taxation and £30,000 for additions and improvements, etc., there is a group net profit for the year ended 30th June last of £167,844, as compared with £143,900 for the preceding year. General reserve receives £100,000 and it is proposed to maintain the dividend for the year at 17½ per cent.

Joseph Lucas (Industries), Ltd.—The consolidated profit for the year to 31st July last, after deducting £5,056,177 for taxation, is £1,801,346, as compared with £1,451,498 for 1953-54. It is proposed to pay a final dividend of 6¼ per cent, making 7½ per cent for the year. This is equivalent to the distribution for 1953-54 when a 2½ per cent interim dividend was paid before a 100 per cent scrip issue. The net profit of the parent company is £1,228,831 (against £1,167,431).

The British Electric Resistance Co., Ltd.—The net profit for the year ended 31st July last is £22,630, after estimated taxation of £23,000, as compared with a profit for the preceding year of £15,736. General reserve received £5,000 and it is proposed to pay a final dividend of 15 per cent, again making 20 per cent for the year. The balance carried forward is £14,805 (against £9,675 brought in).

The Heenan Group, Ltd.—The group profit for the year to 3rd September last is £449,485, as compared with £395,657 for 1953-54, and after deducting taxation, the net balance is £217,009 (against £167,199). General reserve receives £150,000 and it is proposed to pay a final ordinary dividend of 15 per cent (against 12½ per cent), making 20 per cent for the year (17½ per cent). The balance carried forward is £73,343 (against £60,747 brought in).

British Insulated Callender's Cables, Ltd.—It is announced that the issue of 2,650,000 ordinary £1 shares at 38s each has been heavily oversubscribed. About 96 per cent of the 2,470,000 shares offer to ordinary stockholders on a one-for-five basis were taken up. Applications for excess shares totalled 2,500,000 shares and allotments have therefore been drastically scaled down.

S. Smith & Sons (England), Ltd.—The group profit for the year ended 30th July last is £2,635,274, as compared with £2,853,609, and after providing £1,269,405 for taxation and £21,047 minority interests, the group net profit is £1,344,822 (against £1,130,068). The net profit of the parent company is £458,043 (against £478,201). It is proposed to pay a final ordinary dividend of 12½ per cent, maintaining the distribution for the year at 17½ per cent.

The Plessey Co., Ltd.—The preliminary statement for the year to 30th June last shows group trading profits of £1,403,018, as compared with £1,059,206 for 1953-54, and a net balance of £809,023 (against £473,484). General reserve receives £400,000. It is proposed to pay a final dividend of 15 per cent, making 27½ per cent on £800,000 ordinary capital. For the previous year the interim dividend was 10 per cent on £500,000 capital, and the final dividend 10 per cent on capital raised to its present level.

Johnson & Phillips, Ltd.—In announcing an interim dividend of 7½ per cent (unchanged), the company reports that the trading for the current year has been substantially in excess of last year, and the net profit has increased. The proportion of exports to home trade has also increased appreciably, and for the first nine months of the present year was just over 40 per cent of the total. The order book is in a healthy condition. The board is in course of making arrangements for an issue of capital to be made early in 1956.

Veritys, Ltd.—Messrs. P. E. C. Merryfield and J. A. Robertson, who were instrumental in obtaining the calling of an extraordinary meeting of shareholders for 22nd November, have circulated a statement. This expresses the view that the efficiency of the company would be improved by amalgamation with another concern—a view which the directors of the company do not hold. It is thought that the business of Veritys, Ltd., and that of Rye-Arc, Ltd. (ship repairers and general engineers) are complementary and there would be advantages in amalgamating them.

Thomas De La Rue & Co., Ltd., have declared an interim dividend of 10 per cent (against 8 per cent). It is stated that the increase should not be taken as an indication of an increased total for the year to 31st March next.

The Telephone Manufacturing Co., Ltd., has declared an interim dividend of 2½ per cent (same) on increased capital.

New Companies

M.L. Electronics, Ltd.—Registered 21st October. Capital £1,000. To acquire the business of an electronic development and research engineer and electrical equipment manufacturer carried on by J. W. Emmel at Twickenham, as "M. L. Electronics."

(*Continued on page 1007*)

'ENGLISH ELECTRIC', the world-famous manufacturers, use FRY'S Alcho-Re flux in many soldering processes. The above picture (reproduced by kind permission of The English Electric Company Limited) shows the flood-soldering of armature coil leads to the commutator of a DC traction motor. Throughout this process Alcho-Re flux is used for all soldering.

when it's Safety First – use ALCHO-RE FLUX

Alcho-Re fluxes are exceptionally fast in operation, ensure a good spread of solder and are guaranteed non-corrosive. FRY'S Alcho-Re fluxes conform to specification DTD 599 and can be released through our own AID or ARB organisations. Please write for samples and copies of our booklet "*Fluxes for electrical work*".

FRY'S Metal Foundries Limited

TANDEM WORKS, MERTON ABBEY, LONDON, S.W.19.

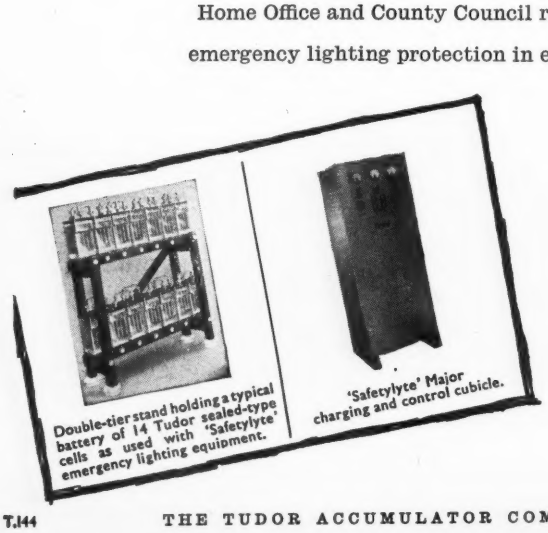
TELEPHONE: MITCHAM 4023

68 *and at MANCHESTER · GLASGOW · BRISTOL AND DUBLIN*

One moment please...

Less than a moment—a split second, in fact—is all the notice Tudor 'Safetylyte' Equipment needs to provide emergency lighting when the mains supply is interrupted. Instant and automatic take-over is assured by the contactor mechanism, and the Tudor batteries that pick up the load are equally ready for action. 'Safetylyte' Equipment is available in compliance with all Home Office and County Council regulations. It offers *complete* emergency lighting protection in every type of public building.

Please send for Publications Nos. 90/93 containing full details of the standard range of 'Safetylyte' Equipment. Comprehensive specifications for special emergency lighting installations prepared without obligation.



Double-tier stand holding a typical battery of 14 Tudor sealed-type cells as used with 'Safetylyte' emergency lighting equipment.

'Safetylyte' Major charging and control cubicle.

TUDOR SAFETYLYTE

EMERGENCY LIGHTING EQUIPMENT

Ready for action in a flash

T.144 THE TUDOR ACCUMULATOR COMPANY LTD, 137 VICTORIA STREET, LONDON, SW1

FINANCIAL SECTION (*continued*)

etc. J. W. Emmel is permanent director. Regd. office: 50, Holly Road, Twickenham, Middx.

Bradnick & Co., Ltd.—Registered 7th October. Capital £2,000. Manufacturers of, agents for and wholesale and retail dealers in electrical goods of all kinds, radio and television sets, etc. Directors: D. C. Bradnick and Mrs. Beryl M. Bradnick. Regd. office: National Provincial Bank Chambers, Five Ways, Birmingham.

E. Wilkes (Electrical Factors), Ltd.—Registered 26th October. Capital £5,000. Manufacturers, importers and exporters of and dealers in electrical, radio, telephone and telegraph apparatus and accessories, etc. The first directors are not named. Solicitors: Banks Newell & Co., Bradford.

Dane Electrical Controls, Ltd.—Registered 25th October. Capital £1,000. Electrical and electronic engineers, manufacturers of and dealers in panel controls, control gear, etc. Directors: H. Bailey, H. E. Bailey and D. F. Mallalieu. Regd. office: Taylor Lane, Denton, Lancs.

Airedale Laboratories (Electronics), Ltd.—Registered 29th September. Capital £1,000. Electronic instrument makers, both medical and industrial, etc. Directors: D. B. Appleby and L. H. King. Regd. office: 16, Hanover Avenue, Leeds, 2.

Arthur Moore (Electrical), Ltd.—Registered 1st October. Capital £1,000. Electrical engineers and contractors, etc. Directors: A. Moore and Mrs. Evelyn C. Moore. Regd. office: Fair Street, Cambridge.

Mitchells (Ovenden), Ltd.—Registered 1st October. Capital £2,000. Radio, television, electrical, refrigeration, heating, lighting, telephone, mechanical and general engineers, etc. Directors: E. Mitchell and Mrs. Alice Mitchell. Regd. office: 155/157, Ovenden Road, Ovenden, Halifax.

Isophonic, Ltd.—Registered 3rd October. Capital £2,000. Importers, exporters, designers, manufacturers and repairers of and dealers in radio and television sets and apparatus, etc. Directors: J. D. Ordish, D. P. Soar, R. E. Parsons and G. R. E. Brown. Regd. office: Wish Road, Eastbourne, Sussex.

Cheb, Ltd.—Registered 30th September. Capital £500. Electrical equipment specialists, manufacturers of and dealers in batteries, accumulators, magnetos, dynamos, etc. Directors: D. E. Cowling, A. V. Holdsworth and E. Berti. Regd. office: 34, Thameshill Avenue, Romford, Essex.

Dan Evans & Co. (Rentals), Ltd.—Registered 19th October. Capital £10,000. Electrical and general wholesale and retail dealers, dealers in washing machines, radio and television sets, etc. Directors: D. J. Evans, A. Evans, G. R. Evans and T. J. Pritchard. Regd. office: 101, Holton Road, Barry, Glam.

Exelements, Ltd.—Registered 14th October. Capital £100. Manufacturers of and dealers in electrical elements and electrical goods, etc. Directors: W. E. Baldwin and Violet H. Baldwin. Regd. office: 56, Wellington Road, St. Johns Wood, N.W.8.

Increases of Capital

Associated Electrical Industries, Ltd.—Increased by £7,000,000, in 1,100,000 4½ per cent "B" cum. preference and 5,900,000 unclassified shares of £1 each, beyond the registered capital of £28,000,000.

L. Weekes (Luton), Ltd.—Increased by £30,000, in £1 ordinary shares, beyond the registered capital of £10,000.

Westinghouse Brake & Signal Co., Ltd.—Increased by £1,000,000, in £1 ordinary shares, beyond the registered capital of £2,500,000.

Newman & Watson, Ltd.—Increased by £140,000, in 2s ordinary shares, beyond the registered capital of £160,000.

Bankruptcies

F. Simons, 15, The Council House, Winchcombe Road, Sedgeberrow, Evesham, electrical contractor.—Receiving order made 1st November on a creditor's petition.

G. E. Stephens, 142-144, Old High Street, Grays, Essex, electrical contractor.—Public examination 20th December at the County Hall, 102, Alexandra Road, Southend-on-Sea.

E. Newland, electrical contractor, 130, Grove Road, Chadwell Heath, Romford, Essex.—Trustee, Mr. D. A. Jacobs, 18, Bentinck Street, London, W.1, appointed 1st November.

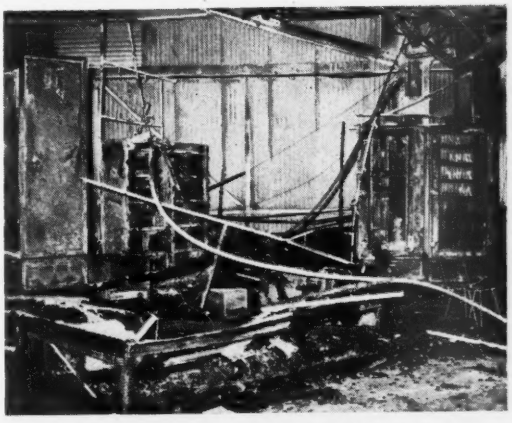
Liquidation

P. L. Dwyer & Co., Ltd., wholesale and retail suppliers of electrical goods.—First and final dividend of 1s $5\frac{15}{16}$d in the £, payable at the office of the official receiver and liquidator, Inveresk House, 346, Strand, London, W.C.2.

Indian Industries Fair

The Indian Industries Fair which opened at New Delhi on 29th October is the biggest of its kind to be held in India. Twenty-one foreign countries are participating in it. Most of the Western countries have their individual pavilions, the biggest participants being the United States with its 100,000 sq ft stand, and Western Germany following close behind with its 60,000 sq ft pavilion. Britain has a small pavilion and the exhibits cover most of the electrical and mechanical industries, the emphasis being on heavy machinery. Among the principal British participants are Babcock & Wilcox, Ltd., who have had connections with India for more than seventy years; Powers-Samas, the accounting machine manufacturers, who recently established a service bureau in Delhi in collaboration with the Planning Commission of the Government of India; the Automatic Telephone & Electric Co., Ltd., whose exhibits ranged from a demonstration model of a large modern automatic telephone exchange to a new portable low-frequency guided radio and v.h.f. equipment (as we reported last week, this stand was destroyed by fire); and Associated Electrical Industries, Ltd. Many well-known electrical firms are represented in the electronics section which shows electronic medical equipment (Newton Victor); a model electro convulsion therapy unit (Edison Swan); search radar for civil aircraft (Ekco); digital computers (Ferranti); electronic soldering iron (Mullard); and tape recorders (E.M.I.). Besides these exhibits in the U.K. Pavilion, many Indian agents or associated firms are showing British-made goods and machinery on their individual stands.

It is probably not realized in some quarters how far the Indian industry has progressed since independence. The index of industrial production which stood at 97·2 in 1947 rose to 146·5 in 1954, an increase of about 50 per cent in seven years. Most of the targets set under the first five-year plan have been attained.



Part of the stand of the Automatic Telephone & Electric Co., Ltd., which was destroyed by fire at the Indian Industries Fair

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (3s 0d each including postage) will be obtainable after 21st December from the Patent Office, 25, Southampton Buildings, W.C.2.

1950

26473. British Broadcasting Corporation. —Reproduction of magnetically recorded signals. 30th January, 1952. Cognate application 26474, 30th October, 1950. (742102.)

1951

24880. Associated Electrical Industries, Ltd.—Barrier layer cells. 23rd October, 1952. (742172.)

29251. Staatsbedrijf der Posterijen Telegrafie en Telefonie.—Electronic device for producing electric pulses which occur in a random manner and which may be used for drawing lots. 13th December, 1951. (742305.)

1952

3837. Automatic Electric Laboratories, Inc.—Telephone system. 13th February, 1952. (742307.)

16296. British Dielectric Research, Ltd. —Production of metallized surfaces. 26th June, 1953. (742056.)

17271. Automatic Telephone & Electric Co., Ltd.—Arrangements for operatively connecting control apparatus with any one of a plurality of equipments. 9th July, 1953. (742249.)

20053. Technograph Printed Circuits, Ltd.—Electric resistance heating devices. 16th July, 1953. (742251.)

22176. General Electric Co.—Asymmetrically conductive units. 3rd September, 1952. (742252.)

23518. Automatic Telephone & Electric Co., Ltd.—Indicator devices. 15th September, 1953. (742254.)

25502. British Fibrak Separator Co., Ltd. —Manufacture of separators for electric accumulator plates from sheet material in ribbon form. 31st July, 1953. (742058.)

27458. Belling & Co., Ltd., and Belling, C. R.—Electric cookers. 1st October, 1953. (742180.)

28805. British Thomson-Houston Co., Ltd.—Multiple contact electric switches. 10th November, 1953. (742114.)

29897. General Electric Co., Ltd.—Electrical circuits including automatic switches. 3rd November, 1953. (742185.)

1953

1883. British Thomson-Houston Co., Ltd. —Manufacture of tungsten filaments. 18th January, 1954. (742063.)

3582. British Dielectric Research, Ltd.— Deposition of material evaporated in a vacuum. 8th February, 1954. (742066.)

3862. Reyrolle & Co., Ltd., A.—Electric protective arrangements. 11th February, 1954. (742189.)

4274. General Electric Co., Ltd., Barsdorf, L. W., and Rycroft, J. L.—Electric supply sockets. 15th February, 1954. (742265.)

6300. General Electric Co., Ltd., and Goodings, D. B.—Electric snap-action switches. 2nd March, 1954. (742068.)

7389. Bulova Watch Co., Inc., New-York, Succursale de Bienne.—Process and apparatus for deriving an electrical voltage in dependence on the momentary position of the regulating device of a timepiece. 17th March, 1953. (742192.)

7795. Sonotone Corporation. — Electric storage batteries. 20th March, 1953. (742193.)

8206. Schloemann Akt.-Ges. Extrusion press for sheathing cables. 25th March, 1953. (742069.)

8391. Standard Telephones & Cables, Ltd.—Magnet assemblies which are long compared to their cross-sectional dimensions. 26th March, 1953. (742070.)

12185. Eastman Kodak Co.—Electric discharge tube and circuit arrangement for measuring gas pressure. 1st May, 1953. (742076.)

12287. Deutsch, E.—Electric heating apparatus for drying or airing articles such as roller towels. 26th April, 1954. (742371.)

12633. National Research Development Corporation.—Electrical measuring instruments. 31st May, 1954. (742078.)

13556. Siemens-Schuckertwerke Akt.-Ges. —Electric switching apparatus having switch chokes. 14th May, 1953. (742081.)

13612. Telefunken Ges. für Drahtlose Telegraphie.—Circuits for generating sawtooth currents. 15th May, 1953. (742082.)

16562. British Thomson-Houston Co., Ltd.—Control circuits. 4th June, 1954. (742143.)

17975. Moteurs Drouard. — Rotary dynamo-electric machines. 29th June, 1953. (742199.)

18674. Johnson & Phillips, Ltd., Hartley, A. C., and Ashby, R. J.—Apparatus for laying submarine cables. 18th June, 1954. (742272.)

18856. Hartley Electromotives, Ltd., and Petrie, J. D.—Mounting means for electrical switches, sockets, and like electrical components in hollow walls. 1st July, 1954. (742090.)

18970. Standard Telephones & Cables, Ltd. — Terminating arrangements for armoured electric cables particularly suitable for submarine cable repeater housings. 2nd July, 1954. Cognate application 30092, 30th October, 1953. (742331.)

19379. Compagnie Générale d'Electricité. —Method of and means for the impregnation of stranded electric conductors and cables or the like. 13th July, 1953. (742091.)

20157. Hawke, W.—Couplings, for securing an end of an electric cable to the casing of an electrical unit. 15th July, 1954. (742149.)

20910. General Electric Co.—Magnetic amplifiers. 28th July, 1953. (742095.)

22382. Southern United Telephone Cables, Ltd.—Means for recording the readings of an instrument or group of instruments. 12th August, 1954. (742334.)

23859. Radio Corporation of America.— Control circuit including a semi-conducting body. 28th August, 1953. (742134.)

25481. Radio Corporation of America.— D.c. restoring or clamping circuits. 15th September, 1953. Addition to 742134. (742336.)

26717. Teletype Corporation.—Transistor relay devices. 29th September, 1953. (742209.)

27364. Robinson, J. G.—Illuminated sign. 6th October, 1954. (742377.)

27675. Philips Electrical Industries, Ltd. —Transistor amplifiers. 8th October, 1953. (742212.)

28040. Applications Electroniques des Caoutchoucs.—Variable electric resistance semi-conductor devices. 12th October, 1953. (742156.)

28107. United Kingdom Atomic Energy Authority.—Diaphragms such as tubular diaphragms between the rotors and stators of induction motor/pump combinations. 13th October, 1954. (742378.)

30094. Standard Telephones & Cables, Ltd.—Method of making sintered electrodes for electrolytic condensers. 30th October, 1953. (742379.)

30633. Naamlooze Vennootschap Hollandse Signaalapparaten.—Device for the generation of pulses for the control of the transmitter and receiver of a radar system. 5th November, 1953. (742217.)

31388. Kent, Ltd., G.—Construction of dynamo-electric machines. 12th November, 1953. (742345.)

32997. Philips Electrical Industries, Ltd. —Television receiving circuits. 27th November, 1953. (742165.)

36354. British Thomson-Houston Co., Ltd.—Electro-luminescent materials. 31st December, 1953. (742355.)

36355. British Thomson-Houston Co., Ltd.—Operation of electric discharge tubes and reactances for use therewith. 31st December, 1953. (742356.)

1954

6701. Automatic Electric Laboratories, Inc.—Line finder systems for automatic telephone exchanges. 13th February, 1952. Divided out of 742307. (742358.)

25041. Automatic Telephone & Electric Co., Ltd.—Arrangements for operatively connecting a plurality of equipments in turn with common apparatus. 9th July, 1953. (742289.) 25042. Registering and translating circuits for use in telecommunication systems. 9th July, 1953. Divided out of 742249. (742290.)

1955

8343/5. Associated Electrical Industries, Ltd.—Barrier layer cells. 23rd October, 1952. (742237/9.)

TRADE MARKS

APPLICATIONS have been made for the registration of the following trade marks. Objections may be entered up to 26th November:—

FENMAN. No. 738,609, Class 9. Radio, radar, television, telegraphic, telephonic and telecommunication apparatus and instruments; electrical, acoustical and electronic apparatus and instruments; signalling, nautical, navigational and echo-sounding apparatus and instruments; electric batteries, accumulators, gramophones, gramophone pickups; microphones, sound amplifying apparatus, loudspeakers, sound records, electric oscillation generators; domestic electric appliances; germanium diodes, transistors; parts and fittings; and electric semi-conducting materials.—Pye, Ltd., Radio Works, St. Andrews Road, Cambridge.

CONSTELLATION. No. 740,735, Class 9. Electrically operated domestic cleaning appliances and parts.—Hoover, Ltd., Perivale, Greenford, Middx.

ALCON. No. 741,429. ALCON (design). No. 741,432, Class 9. Electric switches for use in controlling the action of valves in pipe line systems.—Alexander Controls, Ltd., 141, Wood End Lane, Erdington, Birmingham.

REACTALINE. No. 742,868, Class 9. Instruments and apparatus for measuring, indicating, recording and controlling temperatures, conductivity, hydrogen ion concentration, electric current, voltage, optical density, smoke, atmospheric suspensions and pressure; safety devices being instruments for controlling and indicating failure in gas and electrical equipment; and electric control valves for use with these goods.—Ether, Ltd., Tyburn Road, Erdington, Birmingham.

CHEMIDUS. No. 742,810, Class 9. Electrical apparatus and instruments; scientific and photographic apparatus and instruments; electric accumulators, batteries, cells, accumulator boxes, conduit material, electrodes for electric welding, electric arc welding apparatus; electric vacuum cleaning apparatus; and fermentation apparatus; and parts.—Chemidus Plastics, Ltd., 89, Upper Thames Street, London, E.C.4.

SPEECHMASTER. No. B743,959, Class 9. Radio apparatus, television apparatus, sound reproducing apparatus, microphones, loudspeakers, amplifiers and parts.—Dulci Co., Ltd., Dulci Works, 95-99, Villiers Road, Willesden, London, N.W.2.

UNIVERTER. No. 744,555, Class 9. Television apparatus and parts.—Ikopatents, Ltd., 17, Crisp Road, Hammersmith, London, W.6.

PERMAFIBER. No. 744,378, Class 17. Insulators and insulating material, all made of glass fibre bonded with synthetic resin.—Permali, Ltd., 125, Bristol Road, Gloucester.

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses.

Australia.—25th January. State Electricity Commission of Queensland, Brisbane. 66 kV voltage transformers and relays. (E.S.B. 23185/55. Ten/16573.)*

14th February. Electricity Commission of New South Wales, Sydney. 330 kV circuit-breakers, isolating and earthing switches, insulator stacks, current and voltage transformers. (E.S.B. 24126/55. Ten/16571.)*

Belfast.—1st December. Corporation. Electrical installation at the proposed Orangefield New Intermediate School for Girls. Education Architect's Office, 40, Academy Street.

25th November. Northern Ireland Housing Trust. Electrical installations in 29 dwellings at Monyreagh, Co. Down. Offices of the Trust, 12, Hope Street.

Burma.—24th November. Union of Burma Purchase Board, Rangoon. 120 table fans. (E.S.B. 24044/55. Ten/16557.)*

Co. Down.—1st December. County Education Committee. Electrical installation in Saintfield New Intermediate School and meals kitchen. J. McCandless, consulting engineer, 6, Murray Street, Belfast.

Denbighshire. — Education Committee. Electrical contractors wishing to tender for the remodelling of electrical installations in schools should submit their names by 26th November. (See this issue.)

Durham.—County Council. Electrical installation in Broom Cottages Modern School. (See this issue.)

Formosa.—Taiwan Power Co. Two 30 kW diesel generator sets. (E.S.B. 23162/55. Ten/16580.)*

2nd December. Central Trust of China, Taipei. Ten sets of static capacitors. (E.S.B. 23946/55. Ten/16588.)*

Hereford.—8th December. City Council. Trunk road lighting equipment. (See this issue.)

Horsham.—9th December. U.D.C. Rewiring of Park House. (See this issue.)

India.—6th December. Director General of Supplies and Disposals, New Delhi. Electrically-driven centrifugal and submersible pumps. (E.S.B. 24401/55. Ten/16601.)*

30th November. Stores Purchase Committee, Government of Mysore, Bangalore. Motor-generator sets, wattmeters, overload relays, power factor meter, internal combustion engines and planing machine. (E.S.B. 24636/55. Ten/16648.)* 7th December. Power cables for Thippagondanahalli waterworks. (E.S.B. 24635/55. Ten/16642.)*

4th December. Government Electrical Department, Madras. Air break switches. (E.S.B. 24634/55. Ten/16643.)*

Iraq.—23rd November. Directorate General of Municipalities, Baghdad. 6,600 V and 660 V cable. (E.S.B. 24080/55. Ten/16574.)*

Irish Republic.—7th December. Grangegorman Mental Hospital Board. One 10,000 lb/hr boiler (alternatively 7,500 lb/hr and 6,000 lb/hr), complete with chain grate stoker, induced draught fan with steam and electric drive, insulation, soot blowers, etc., for Portrane Mental Hospital, Donabate, Co. Dublin. (E.S.B. 24188/55. Ten/16593.)*

Lanark.—12th December. County Council. Trunk road lighting equipment. (See this issue.)

Liverpool.—3rd December. Regional Hospital Board. Electrical engineering services at Hesketh Park Hydro, Southport. H. M. Cooke, regional engineer, 2, Union Street, Liverpool.

London.—30th December. India Store Department. Billet heating furnace and heat treatment and ageing furnace. (See this issue.)

Rhodesia and Nyasaland.—Federal Hydro-Electric Board. Water turbines, generators and 330 kV transformers for the Kariba scheme. (See this issue.)

9th December. Federal Tender Board, Causeway. Private automatic branch exchange. (E.S.B. 24233/55. Ten/16612.)*

21st December. Bulawayo Electricity Department. H.v. cable fault locator, substandard voltmeter, reed type tachometer, voltage detectors and tong type ammeter. (E.S.B. 24090/55. Ten/16583.)*

Rochdale.—28th November. Borough Council. Installation of electric lighting and power at Castlemere School. Borough surveyor, Town Hall.

St. Helens.—Education Committee. Firms wishing to tender for the electrical installation, etc., at Carr Mill Junior School should apply by 24th November. (See this issue.)

Saudi Arabia.—27th November. Ministry of Defence. Electrical appliances and accessories. (E.S.B. 24668/55. Ten/16658.)*

South Africa.—23rd November. Stores Department, South African Railways. Electrically driven pumps. (E.S.B. 24311/55. Ten/16577.)*

2nd December. Durban Electricity Department. Electricity meters. (E.S.B. 23126/55. Ten/16569.)*

8th December. Union Tender and Supplies Board. Radio components. (E.S.B. 24521/55. Ten/16618.)* Dynamometers. (E.S.B. 24526/55. Ten/16622.)*

United States.—6th December. Bonneville Power Administration, Portland, Oregon. Four 50,000 kVA single-phase transformers. (E.S.B. 24255/55. Ten/16632.)*

West Riding.—County Councils. Electrical installation contractors wishing to be placed on the Council's list of contractors should apply by 31st December. (See this issue.)

Wigan.—29th November. Borough Council. Electrical work for housing schemes. Borough engineer, Municipal Buildings, Hewlett Street.

ORDERS PLACED

Brentford and Chiswick.—Corporation. Mercury vapour lighting in a number of roads (£14,857).—Revo Electric Co.

Brighton.—Town Council. Supply of four bogey-type cars for Volk's Railway (£26,400). —Maley & Taunton, Weymann Motor Bodies, and Crompton Parkinson (jointly).

Farnworth.—Corporation. Electrical installations in 45 flats on the Albert Road site (£2,069).—Dawson & Gent.

London.—L.C.C. Electric lifts at various housing estates (£310,020).—Express Lift Co.

Manchester.—Housing Committee. Electrical installation work in 122 flats (Contract 211) and 126 flats (Contract 227) and in 23 houses and cottage flats (Contract 210) on the Langley estate.—F. L. Bampton.

Newcastle-on-Tyne.—City Council. 100-line intercommunicating telephone system for the Transport and Electricity Department (£3,515).—Reliance Telephone Co.

Peterborough.—Improved lighting in Lincoln Road (£7,671).—Machinery Installations.

Stoke-on-Trent.—City Council. Recommended. Electrical installation work in the City Museum and Art Gallery (£2,570).—Speed Electrical Services. Electrical installations in 70 houses on the Norton estate (£1,926).—H. E. Charlesworth.

Wallasey.—Education Committee. Electrical installation work at Lingham Junior Mixed School (£2,024).—Lindsay Crawford Engineering. Installation work at Church Street School (£1,830).—F. H. Ashworth.

WORK IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

Abingdon.—Laboratories; Esso Development Co., Ltd., 33, Davies Street, London, W.1.

Barnstaple.—Factory, Braunton Road; Hobart Manufacturing Co., Ltd., Lion Works.

Belfast.—Hospital for women and children, Dundonald; Frederick Gibberd, architect, 8, Percy Street, London, W.1.

Billingham. — Extensions to college (£15,000); county architect, Durham.

Bradford.—Houses (293), Tong estate; John Laing & Son, Ltd., Dalston Road, Carlisle.

Fire station at Idle (£32,600); W. H. Leathem, town clerk, Town Hall.

Brighton.—Old folks' home, Craven Vale estate; engineer and surveyor, 26, King's Road, Brighton.

Cambridge.—Secondary grammar school, Queen Ediths Way (£170,000); T. V. Burrows, borough surveyor, Guildhall.

Castle Ward.—Cinema, Ponteland; G. Cowan, Imperial Buildings, 94, Westgate Road, Newcastle-on-Tyne.

Crawley.—Works; Close Tolerance Castings, Ltd., 103, Cannon Street, London, E.C.4.

Creswell.—Secondary modern school; J. Dudding & Partners, architects, 30, Clarendon Street, Nottingham.

Darlington.—New Haughton C. of E. Modern Technical School; Edgar Lawson, Ltd., builders, Albert Hill, Darlington.

Derbyshire.—Breaston Secondary Modern School; S. Morrison & Partners, architects, 103, Belper Road, Derby.

Durham.—New schools for the C.C. at Barnard Castle, Hartlepool, Billingham, Felling, Middleton-in-Teesdale, Peterlee, Trimdon, Ushaw Moor, Wolsingham and Willington and additions to Washington Grammar Technical School; county architect, Court Lane, Durham.

Essex.—Secondary modern schools at Basildon Woodlands and Brentwood South (£185,000 and £140,000 respectively), for Essex E.C.; H. Conolly, county architect, County Hall, Chelmsford.

Great Wyrley.—Factory; C. & H. Howe, locks, Gomer Street West, Willenhall.

Hartlepool.—Houses (97), Blandford Street; J. H. Wood, borough engineer.

Hendon.—Houses (184), Claremont Road; A. O. Knight, borough surveyor, Town Hall, N.W.4.

Hinckley.—Blocks of 3-storey flats, Jericho estate; Council's architect.

Hornchurch.—Shops and maisonnettes, High Street; P.I.T., Ltd., 8, Queen Street, Mayfair, London, W.1.

Houghton-le-Spring.—Public hall, Dairy Lane (£10,000); U.D.C. surveyor.

* Specifications may be inspected at the Export Services Branch, Board of Trade, Lacon House, Theobald's Road, London, W.C.1 (Chancery 4411; extension 769).

Hove.—R.C. church, Court Farm Road; S. D. Hicks, architect, 37, De Cham Road, St. Leonards-on-Sea.

Factory, Leighton Road; British Engraving & Name Plate Co., Ltd., 5, Fitzroy Street, London, W.1.

Hull.—Crematorium, Chanterlands Avenue; Charlton & Crowther, architects, 21, Bond Street, Leeds.

Second stage of college of technology; J. Roger Preston & Partners, mechanical consultants, 15, North Audley Street, London, W.1.

Ipswich.—Rebuilding Central Cinema, for Owen Cooper Theatres, Ltd.; L. C. Norton, architect, 4, St. George Street, Hanover Square, London, W.1.

Irlam.—Ten blocks of flats, Glaze estate; P. Bracegirdle, Cadby Lodge, Springfield Lane.

Kidderminster.—Factory and offices, Stourport Road/Walter Nash Road; National Standard Co., Ltd., wire braids, Stourport Road, Kidderminster.

Lewes.—Dwellings (60), De Montfort estate; Ringmer Buildings Works, Ltd., Ringmer.

Liverpool.—Stage 1 of large new factory for AC Delco Division of General Motors, Ltd.; John McGeogh & Son, Ltd., Arbour Lane, Kirkby industrial estate, Liverpool.

London.—Surgical block, Guy's Hospital; Watkins, Gray & Partners, architects, 57, Catherine Place, S.W.1.

Factory, Lytham Street, Walworth; F. C. Savage & Son, Ltd., Merrow Street, S.E.17.

Offices, Vauxhall Bridge Road; J. G. Blythe & Co., Ltd., builders, 9, Baring Road, S.E.12.

Luton.—Printing works in Crescent Road; J. Staddon & Son (Luton), Ltd., printers and stationers, 12, Bute Street.

Maidstone.—Works extensions; A. E. Reed & Co., Ltd., Tovil Works.

Manchester.—Stage 1 of Central Highways Depot, King Street, Ardwick; Fred Mitchell & Sons, Ltd., Manchester.

New chemical engineering buildings at College of Technology; Harry S. Fairhurst, architect, 55, Brown Street.

Morpeth.—Extensions, Thomas Taylor Homes (£73,000); county architect, County Hall, Newcastle-on-Tyne.

Admission block and two convalescent blocks, St. George's Hospital (£300,000); Newcastle-on-Tyne Regional Hospital Board, Osborne Road, Newcastle.

Newbury.—Divisional police headquarters and court house for Berkshire C.C.; county architect, Wilton House, Parkside Road, Reading.

Newcastle-on-Tyne.—Eight-storey luxury hotel; Cussins (Contractors), Ltd., The Drive, Gosforth.

North Shields.—Factory for Fish Meal & Oil Co., Ltd.; Tasker & Child, Trinity Buildings, New Bridge Street, Newcastle-on-Tyne.

Factory, Bird Street, for Major Equipment, Ltd.; L. G. Wood, 17, Northumberland Square, North Shields.

Northumberland.—Child welfare centre at Shiremoor (£10,000) and additions to Thomas Taylor Homes at Stannington (£73,000); county architect, County Hall, Newcastle-on-Tyne.

Nuneaton.—Factory, Weddington Road; Abbott Hosiery Co., Ltd., Trinity Lane, Hinckley.

Oldham.—Town hall and municipal offices; A. L. Hobson, borough surveyor, Municipal Buildings, 75, Union Street.

Oxford.—Second phase of scheme for college of technology, art and commerce (£303,000); E. G. Chandler, city architect, Town Hall.

Preston.—Extensions to factory at Walton-le-Dale for Atkinson Vehicles, Ltd.; Lillie & Kirkham, architects, 25b, Winckly Square.

Radcliffe-on-Trent. — Secondary school; W. J. Simms, Son & Cooke, Ltd., Haydn Road, Nottingham.

Reading.—Mid-South Secondary School for Girls; Howard V. Lobb & Partners, architects, 20, Gower Street, London, W.C.1.

Ruislip.—Crematorium; Dahl & Cadman, consulting architects, 3, Bouverie Road West, Folkestone.

St. Leonards-on-Sea.—Factory, Theaklen Drive; Royston Carr & Co., Ltd., Sutherland Road, London, E.17.

Salford.—Development of Lower Kersal housing site; Cruikshank & Seward, architects, 196, Deansgate, Manchester.

Saltburn (Yorks).—Houses (60), Marske; U.D.C. surveyor, Council Offices, Saltburn.

Sheffield.—New library buildings for University; Gollins, Melvin Ward & Partners, architects, 15, Manchester Square, London, W.1.

Southgate.—Office block, High Street; Woolwich Equitable Building Society, Ltd., High Street, London, S.E.18.

Southport.—Houses (89), and eight two-storey flats, Burnley Road estate, Ainsdale; town planning officer, 99/105, Lord Street.

Stafford.—Proposed police headquarters, Baswich House; C. M. Coombs, county architect, County Buildings, Stafford.

Sunderland.—Castle View Infants' School (£42,000); Tate and Holmes, builders, Benwell, Newcastle-on-Tyne.

Swansea.—Office block; Bennett Bros., Ltd., Heathfield Works, Carlton Terrace.

Swindon.—Factory; Listafoam Industries, Ltd., 24a, Portland Place, London, W.1.

Tynemouth.—Secondary technical school; G. H. Gray & Partners, Camden Street, North Shields.

Wakefield.—Houses (100), Kettlethorpe estate; N. B. Bell & Co., Ltd., Frankland Terrace, Leeds, 7.

West Bromwich.—Factory, Colliery Road, for Phillips Telescopic Taps, Ltd.; J. E. Williams, Ltd., 163, Victoria Road, Birmingham.

Wood Green.—First stage of municipal offices and town hall; Stinton Jones & Partners, electrical consultants, 21, Gloucester Place, W.1.

Development of Wyrley Birch estate, Perry Common, to provide homes for 1,300 persons (four eight-storey blocks as first instalment); A. G. Sheppard Fidler, city architect, Civic Centre, 1.

Office block, workshops, canteen, etc., Ringwood Road; Boyland & Son, Ltd., Fernheath Road, Winton.

Worksop.—School, Kilton estate, for Notts C.C.; J. E. Smith (Worksop), Ltd., Kilton Road, Worksop.

Electric Blanket Fatalities

Three inquests were held recently, two at Halifax and one at Otley, in connection with deaths as the result of using electric blankets or warming pads.

Recording a verdict of "Death by misadventure" on Westwood Hodgson, aged 51, of Halifax, who was found dead in bed, lying on an electric blanket, the Halifax Coroner, Mr. B. W. Little, added a warning that people should not sleep with an electric blanket switched on. When the house in which Hodgson was found was broken into by the police, it was found that on the mattress of the bed was an electric blanket and over it two woollen blankets, and over the dead man lay three blankets, an eiderdown and a bedspread. As the electric blanket was cold and the switch off it was thought at first that it was a case of natural death, but a doctor then found burns on Mr. Hodgson's back. The blanket was tested for the police by Mr. A. E. Elson, district commercial engineer of the Yorkshire Electricity Board. There were no signs of overheating and two thermostats were fitted. He laid the electric blanket on an ordinary blanket, covered it with two more and inserted thermometers. He piled on three more blankets, switched on and left the blanket for five hours. In that time the temperature rose from 62 deg to 156 deg F, the thermostats not having worked at all.

The other inquest at Halifax concerned a four-day-old premature baby who was fatally burned at Halifax General Hospital by an electric warming pad which was in the baby's bed instead of being on top of the cot. A part-time member of the nursing staff, who unwittingly placed the baby on the warming pad, said that no one had ever told her the rules about the use of such pads in the hospital. She did not know that they were always placed on the top of the babies' cots. When she saw a flex hanging from the cot in question she assumed that the pad had been placed under the mattress, which she said she had often seen done. She failed to notice that the pad was in the child's bed because it was coloured white like the sheets. The Coroner stressed that instruction should be given to all nurses about the use of pads. Referring to a statement made in evidence that all electric pads at the hospital were now being fitted with red covers marked "Danger," Mr. Little said it was a pity this had not been done earlier.

The inquest at Otley also concerned a four-day-old baby, who died from shock following burns when left over five hours in an electrically-heated and thermostatically controlled cot in Otley General Hospital. The jury, returning a verdict of "Misadventure," added that in their opinion it was desirable that there should be better supervision of electrical equipment in hospitals. The Coroner, Mr. S. E. Brown, commenting on the evidence of tests made by Professor G. W. Carter, Professor of Electrical Engineering at Leeds University, said that they showed that the heat of the cot mattress did not for a comparatively short period rise very high, but after the equipment had been on for some time the temperature rose much higher. After half-an-hour the temperature on the mattress was 92 deg F, after an hour 103 deg and after two hours 110 deg. The Coroner said that it appeared that the instructions said to have been received with the equipment contained no very adequate warning. Professor Carter had also expressed the opinion that a temperature range of 18 deg at one thermostat setting appeared to be excessive for the purpose.